Studies of the Homopterous Families Cercopidae and Jassoidea

With Special Reference to the South African Fauna

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Graduate School of the Ohio State University

by

ERIC SYDNEY EARLE COGAN

Columbus, Ohio

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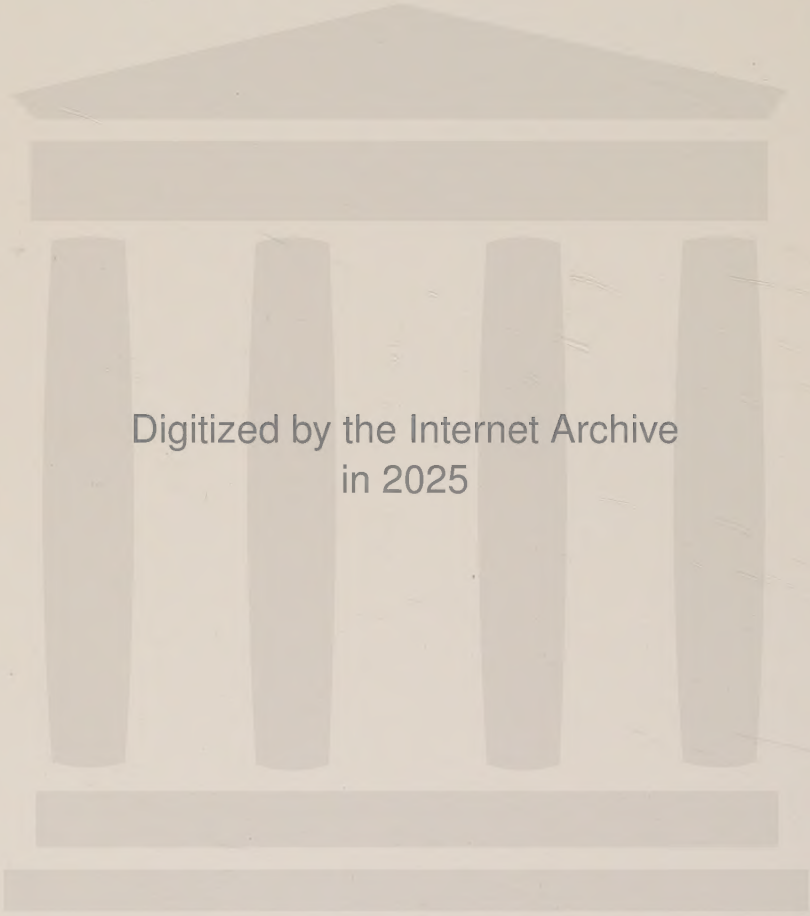
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HOMOPTEROUS STUDIES. PART I.

Contribution Towards Our Knowledge of the Homoptera of South Africa.

ERIC S. COGAN, M. A.

INTRODUCTION.

The systematic treatment of the Auchenorrhynchous Homoptera of South Africa has received but little attention from entomologists and naturalists, with the result that the worker or investigator finds himself confronted with what may be termed a pioneer task. Of all the orders of insects in South Africa, the Hemiptera and particularly the suborder Homoptera have been studied the least. The list of described species, at all events for the Auchenorrhynchous Homoptera, would scarcely number more than one hundred. The Cicadidæ and Fulgoridæ are perhaps the best known, yet our knowledge of these two large families is far from complete. The Membracidæ have received but passing comment, while the Cercopidæ and Jassoidea are scarcely known at all.

Through the courtesy of Professor Osborn of the Ohio State University, the writer was afforded an opportunity to study a series of Cercopids and Jassids, which had been consigned to him for study by Mr. Mally, of the Department of Agriculture in the Cape Province. Except in a few cases where the specimens had faded a little, the collection was in a good state of

preservation. In all some thirty-eight forms were studied and the results are embodied in the following pages.

It will be seen that the generic descriptions have been given; and this is done in view of the fact that the writer here wishes to lay the foundation for future extensive study of the families concerned. In some cases species have been redescribed fully, because the original descriptions are brief, totally inadequate, and not readily accessible to the average worker. Where species are described as new the writer has endeavored to present, as far as possible, accurate drawings to supplement the descriptions. On account of the growing importance of the ecologic and economic relationships of Insects, a short discussion of these two phases of study is given.

The types of new species will be deposited in and numbered at the South African Museum, Cape Town.

ACKNOWLEDGMENT.

I desire here to express my sincere thanks to Professor Osborn, of the Department of Zoology and Entomology of the Ohio State University, for much valuable suggestion and criticism, and for facilities placed at my disposal; to Mr. Hewitt of the Albany Museum, for the loan of specimens and to my father, Mr. R. J. Cogan, for material forwarded to me for study.

HISTORICAL.

The earliest references to the Homoptera of South Africa are contained in Linne's work, Systema Natura, Ed. X, published in 1758, wherein the descriptions of four Cicadas and a Fulgorid are contained. During the same century, Fabricius was responsible for the descriptions of some few forms which had been collected by the early voyagers and explorers of the Cape of Good Hope. Among others De Geer may be mentioned as contributing to our knowledge during the same period. The first half of the nineteenth century was not productive of many workers in the suborder—Germar, Westwood, Guerin, Anyot and Serville, Thunberg and Burmeister, were perhaps the most prominent. But the year 1850 saw the appearance of Walker's List of Homopetra in The British Museum and during the succeeding two decades, considerable work was done by Stal, Signoret and Westwood.

Walker's List with Supplement was completed in 1858, and contained the descriptions of numbers of South African Genera and species. Concerning his work, Distant has written: "Walker was a prolific and somewhat hasty writer, and the value of his work was very uneven. His name is however associated with and never can be excluded from the annals of the South African Homoptera, or scarcely from those of any other region: he was a pioneer, though his survey required and still requires much supervision."

Stal's monumental work, Hemiptera Africana appeared in 1866, and is held today as the most comprehensive work ever accomplished on the order, so far as South Africa is concerned. Of him Distant writes: "Stal built on his own foundation, he possessed a genius for taxonomy; what Lacordaire did for Coleoptera, he more than achieved for the Rhynchota and his work may be further elaborated, but will never be superseded. He was a severe critic of Walker's work and even proposed its suppression." Stal wrote almost exclusively in Latin with a style all his own, and it has been the lot of many Hemipterologists to experience difficulty in translating many of his expressions. He apparently collected in South Africa, although the majority of his work was done on Museum material.

Associated with the names of Stal and Walker may be mentioned Signoret, the French collector and taxonomist. During the years 1853 to 1856, he published in the Annals of the Entomological Society of France, quite a number of descriptions of South African Homoptera, chiefly of the family Jassidæ. Later (1880), his "Essai sur les Jassides" appeared.

Of the more recent workers and investigators, the names of Distant (Rhynchota), Melichar (Homoptera), Karsch 1890, (Fulgoridæ), Buckton 1903, (Membracidæ), Schouteden 1901, (Cercopidæ), and Jacobi 1904, (Cercopidæ), stand out prominently. Distant is perhaps the highest living authority on the Homoptera of South Africa and has contributed many valuable works on the group. Chief among these may be mentioned his "Synonymic Catalogue of Homoptera," his "Insecta Transvaaliensia," and many papers in the Annals and Magazine of Natural History. Melichar's work has been restricted somewhat to the German East African province, where he has collected extensively and described numbers of forms.

With the rapid development of Agriculture in the South African provinces, more attention is being paid to the study of Entomology and since a knowledge of systematic work is indispensable to the economic worker, the study of the Hemipterous order is receiving more attention. The Homoptera will necessarily come in for their share of study and one may predict a healthy development in the near future of our knowledge of this group.

ECONOMIC.

The development of the study of Economic Entomology has brought to light the fact that many of the supposedly insignificant and inconspicuous forms of insects are in reality responsible for a great deal of damage to the crops of man. During recent times attention has been paid to the investigation of many Homopterous insects with the result that the Jassids have been found responsible for a great deal of injury to grains, grasses and cereals; besides native grasses, plants and trees. Although as yet none of the Auchenorrhynchous Homoptera in South Africa have been proven to be of great Economic Importance, it would be unsafe to say that such would always be the case. Distant in his Insects Transvaaliensia, points out that "as many of the species generally referred to as "Leafhoppers" by American Entomologists, are undoubtedly injurious to several trees and crops, a knowledge of them, however partial, is of economic importance." Osborn further states that "the leafhoppers affecting the cereal and forage crops constitute a very constant factor and the extent of the drain on such crops is doubtless much greater than is appreciated."

Entomological work in the United States and territories has revealed the depredations of many members of the Homopterous suborder: thus the Periodical Cicada (Cicadidæ), the Buffalo Tree-Hopper (Membracidæ), the Sugar Cane Leafhopper (Fulgoridæ) in Hawaii, and the many Froghoppers (Cercopidæ) and Jassids (Jassoidea), may be cited as examples of the general importance of the group from an economic standpoint. Records of extensive injury to crops by members of the superfamily Jassoidea are obtainable in the United States—thus Deltocephalus inimicus, Athysanus exitiosus, Dræculacephala mollipes and D. reticulata, Agallia sanguinolenta, and Cicadula 6-notata, constitute in some parts a great

enemy to the cultivation of cereal and forage crops. Empoasca mali on Apple and Typhlocyba comes on Grape may also be mentioned to show the effect on plants other than grasses and cereals.

The Jassoidea and Cercopidæ are not restricted to grasses, but are equally formidable in their attacks on fruit trees, garden crops and shade or forest trees. Although their attacks are not as prominent or apparent as those of the Locusts or Scale Insects in South Africa, yet by their inestimable numbers they are considered to account for much of the trouble, which is usually ascribed to other causes.

Their method of attack is restricted almost entirely to the sucking of the plant juices and sap, thus causing a general wilting of the parts affected. The leaves and younger stems are especially affected and the result is generally seen in the small brown spots, indicating the punctures of the insect's "beak." Where immense numbers of these minute insects attack a crop, it can easily be seen that the incessant and constant drainage of the sap will result in some material loss.

As pointed out before, none of the South African leafhoppers have yet proven to be of great economic importance, but the general distribution and common occurence in meadows and pastures of Athysanus capicola makes it a very suspicious species. Added to this, the six-spotted leafhopper, Cicadula 6-notata is now reported from the Cape Region and when one considers its work in North America and Europe, it would not be unfair to expect a similar state of affairs in South Africa.

The practice of burning the grass or veldt, is one which though not very strongly recommended by the botanists, nevertheless, serves to keep down the grassfeeding species of Jassids. Owing to the nature of farming in South Africa, the control conditions must necessarily be of a restricted variety, and local more than general methods recommended.

ECOLOGIC.

Osborn states that "the leafhoppers constitute one element in a very complex relation of plants and animals, including birds, mammals, reptiles, toads, insects and spiders, etc., and it is only by the recognition of this relation that we can offer any adequate explanation of their proper place in nature, and of their importance in the economy of cultivation. Primarily

they are associated with certain kinds of plants upon which they depend for their sustenance and the abundance of leafhoppers will be affected, necessarily, by the abundance of the food plant and its availability as food material. An undue increase of the leafhoppers, which should result in the diminution of the food supply, must necessarily affect the possibilities of multiplication and cause a certain reduction in the number of the insects. This is by no means the only statement of conditions, as, aside from these two forms which may be associated in the same area, a large number of other organisms, both plant and animal, will affect the problem. The occurrence of different birds and predaceous insects which prey upon the leafhoppers will naturally reduce their numbers and to that extent favor the plants which serve as their food, whereas the presence of herbivorous animals, grasshoppers, cutworms, etc., serves to reduce the available food supply. Aside from these dominant forms, there are also various fungus parasites which attack both insects and plants and which play their part in the complex, of which the leafhoppers are such a conspicuous element. Furthermore, the minute insect parasites which attack the leafhoppers add their part, tending to keep the latter reduced in numbers."

Some of the points here mentioned are well borne out in South Africa; thus the increase in vegetation from the west to the east, is followed by a great increase in the numbers of forms, with the result that the Eastern Province and Transkei territories (the Caffraria of Stal), contain a greater number of individuals. It must be emphasized here that but mere passing comment on the ecological relations can be given, as our knowledge of the group precludes any but bare statements of recorded observations. The presence in South Africa of a fauna restricted almost entirely to the dry Karroo region, makes the study of ecology an interesting one. Added to this the subtropical character of the climate and vegetation of Natal, and the northern regions, one is confronted with a variety of conditions scarcely paralleled on any other continent. Many of the endemic genera and species are restricted almost entirely to the Karroo region.

The relations of the higher animals to the Homopterus fauna can only be touched on. While it is known that herbivorous animals in foraging, are likely to swallow the eggs, yet the

matter is of minor importance. As with the locusts, the birds must necessarily constitute some check on the increase of the fauna. The writer recalls the swallows feeding extensively on Jassids in the district of Albany. Another interesting fact is recalled, and that is the habit of the common "Butcher Bird," which catches and impales various insects, such as Grasshoppers, Cicadas, Fulgorids and Jassids, on barbed wire fences and on thorns of trees such as the "Mimosa." Distant records that "birds are dangerous to Cicadan life," and further reports having seen a Cicada, *Platypleura diversa* Germ. eaten by spiders. Ross records the eating of *Quintilia carinata* Stal by a mantis (*Miomantis fenestra* Fab.). Near Rustenberg he observed *Callipsaltria longula* Stal being attacked by a Cicindelid beetle. Bell-Marley writes of an interesting interrelationship existing between a Membracid *Oxyrhachis tarandus* Fabr. and certain small red ants; the cause of the association being the secretion of honey dew by the Membracids.

The protective resemblances borne to plants and flowers by many African Homoptera, constitute an interesting association and are worthy of mention here. *Cephalelus infumatus* is perhaps the best and most striking example, and the case of mimicry is mentioned under that insect later. Distant records a resemblance to twigs and branches by a Cicada, *Platypleura haglundi* Stal, and Ross attributed the difficulty in collecting *Platypleura marshalli* Dis. to its resemblance in color to the "mopami" tree. Hinde has drawn attention to the resemblances borne by *Flata nigrocincta* Walk. to flowers of a plant in East Africa.

While many interesting ecological facts await the investigator, it seems to the writer that none too much stress can be laid on the importance of such study. The various predaceous and parasitic insects must necessarily be studied before we can obtain any definite information on the ecological relationships.

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FAMILY CERCOPIDÆ.

This interesting family is characterized by the shape of the hind tibiæ, which are cylindrical and armed with two spines on the outer side, one near the base, and the other a little beyond the middle, the former once and the latter twice as long as the tibiæ are wide. Tibiæ and first two joints of the tarsi terminated with a crescent-shaped row of spines, and the third joint with a bifid claw. Frons usually tumid and convex or compresso-produced. Antennæ inserted between the eyes. Two ocelli located on the disc of vertex. Pronotum sixangular or trapeziodal; scutellum triangular or rhomboidal. Elytra coriaceous, more or less covered with a fine pubescence.

The family comprises the well-known "Cuckoo-spit," "Frog-hoppers," or "Spittle Insects," so called from the frothy enveloping exudate in which the early history of the insect is spent. The chief works on this family are those of Walker, Stal, Distant, Schouteden and Jacobi.

TABLE OF SUBFAMILIES OF CERCOPIDAE.*

1. Anterior margin of the thorax straight, eyes equally as long as broad..... *Cercopida Stal.*
2. Anterior margin of the thorax rounded or angular: eyes frequently transverse. *Aphrophorida. Stal.*

SUBF. CERCOPIDA Stal.

SYNOPSIS OF GENERA.*

A. Front without a longitudinal carina.
   a. Front with a longitudinal sulcus.....**Rhinaulax. A. & S.**
AA. Front with one or more than one longitudinal carina at middle. Front with one carina.
   b. Carina weak, not well developed.....**Locris. A. & S.**

Genus **Rhinaulax** A. & S.

Head broad, the front convex and broadly flattened or impressed from the middle of the base to beyond the middle of the length. Ocelli remote from the eyes. Antennæ three-articulate, extending out almost from the sides of the head. Thorax truncate before the base of the scutellum. Scutellum equilateral.

*Adapted from Stal.

Rhinaulax analis Fabr.

Cercopis analis, Fabricius. Ent. Syst. IV. 49. 7. (1794).
id. Syst, Rhyng. 93. 23. (1803).
Cercopis bicolor, Fabr. Ent. Syst. Suppl. 523. 11. (1798).
id. Syst, Rhyng. 93. 26. (1803).
Cercopis trifurca, Thunb. Hem. Rostr. Cap. 1. 4. (1822).
Tettigonia bicolor, Thunb. Hem. Rostr. Cap. 1. 7. (1822).
Rhinaulax maculipennis, Am. & Serv. Hist. Hem. 561. (1843).
Rhinaulax analis Stal. Hem. Afr. IV. 65. (1866).
Rhinaulax analis Distant. Ins. Transv. IX. 227. (1908).
Rhinaulax analis Walk. List. Hom. B. Mus. Suppl. 667. (1851).

General color black, with the elytra red, or varied. Length of female and male, 8 mm. Breadth 3 mm.

Vertex black, short, the anterior margin rounded, three times as broad as its length. Ocelli black, located closer to one another than to the eyes. Eyes oval, grayish black in color. Face black, the frons tumid, flattened on the middle, with numerous transverse furrows; clypeus produced, flat; rostrum long, black. Pronotum black, finely punctate, with indistinct rugæ, much broader than the head; a median longitudinal line; length about two and a half times as long as the vertex; convex above. Scutellum long, the apex sharp, depressed on the middle, with indistinct transverse striations; not quite as long as the pronotum. Sternum of thorax black. Elytra red at base, yellowish towards the apex black along the inner margin. Abdomen black above, beneath black, with the posterior edges of the segments red; red at base. Genitalia of male rather obscure; last ventral segment about twice as long as the penultimate; plates long, rounded.

Habitat: Caffraria (Castelnau), Cape Colony (Distant), Post Elizabeth, Simonstown (Oxford Museum), Rosebank C. P. (Brain).

Rhinaulax analis var. **bicolor.**

Black, with the elytra yellowish green, with black along the inner margin and brownish on the apical area. Abdomen black, with yellowish at base. Last ventral segment of female reddish; pygofers long and flattened, the ovipositor a little longer.

Habitat: Newlands, C. P. (Brain) and as above.

This species is most variable, Stal having described no less than three different varieties. The variety 'bicolor' seems to have a very general distribution over Cape Province, but is as yet not recorded from the neighboring provinces.

Genus **Locris** Stal.

Frons very tumid, convex, prominent in front and below; viewed from the side, neither compressed nor angular in form unless very obsolete; provided with a distinct carina on the

middle. Antennæ very short, ocelli further removed from the eyes than from one another. Base of thorax truncate. Scutellum subequilateral.

"According to our present knowledge, this is distinctly Ethiopian Genus. It is also a most extensive one, some forty two species having already been described. As pointed out by Stal, two subdivisions of the genus are possible by the character of the surface of the pronotum." (Distant).

A. Pronotum very coarsely punctate and posteriorly rugose.
B. Pronotum distinctly punctate but not posteriorly rugose.

A. Locris arithmetica Stal.

Locris arithmetica Stal Hem. Afr. IV. 58. (1866).
Monecphora arithmetica Walk. List. Hom. B. Mus. 675. (1851).
Locris arithmetica, Dist. Ins. Transv. IX. 227. (1908).

General color bright red, interspersed with black marks on the head, thorax and elytra. Ventral color black, the whole covered with a dense pubescence. Length of both male and female 12.5 mm. Breadth 4.5 mm.

Head small, much narrower than the pronotum; vertex produced anteriorly, its length about equal to the width across the eyes; anterior half of vertex red, the posterior, dense black. Eyes large, dark gray. Frons black, red at the anterior margin of the head, very tumid; longitudinal carina rather poorly developed; numerous deep transverse furrows; cheeks very small and rostrum long. Pronotum a little more than one and a half times as long as the vertex, narrow next the head, widening considerably towards the elytra; black on the anterior half, except along the lateral margins which are red; the red band continuous across the middle. Posterior margin black; pronotum very convex, finely punctate, the punctations occupying fine rugæ on the posterior half; anterior half with numerous small depressions or irregular pits; lateral posterior angles of the pronotum obtuse, the posterior margin inwardly rounded; lateral edges red, black beneath and shining. Scutellum jet black. Elytra bright red, marked characteristically with six large black spots, two near the base, one on the claval area, another on the corium, a smaller spot on the claval suture, just before the apex, one larger at the apex, and the last on the middle of the elytron. Venation rather indistinct. Hind wings slightly lurid. Abdomen brown above, beneath black but reddish at base, the posterior edges of the segments red. Legs black at base, the tibia bright red and the tarsi black. Posterior tibiæ with the median spine well developed. Genitalia indistinct.

Habitat: Transvaal, Pretoria (Distant), Johannesburg, (Cruger, Brit. Mus.), Boksburg (Kaessner), Natal (Mansell Weale), Durban (Bell-Marley), Howick (Cregoe), Bechuanaland, Omaramba (Erikson), Kaffraria, (Castelnau, Oxford Mus.)

Tegwani (Brain), Debe Nek (Brain), Metabele Land (Oates, Oxford Mus.), Mashonahand (Salisbury, Marshall), Cape Colony (Mansell Weale), King Williamstown (Barrett). "Africa meridionalis occidentalis" (Stal).

B. Locris transversa Thunb.

Cercopis transversa, Thunberg. Hem. Rostr. Cap. 1. 4. (1832).
Monecphora phœnicoptera, Walk. List Hom. Brit. Mus. 111. 676. (1851).
Monecphora fuscicollis, Stal. Ofv. Vet. Ak. Forth. 95. (1855).
Locris transversa, Stal. Hem. Afr. IV. 61. (1866).
Locris transversa, Dist. Ins. Transv. IX. 228. (1908).

Black with red on the head and thorax. Elytra red, yellowish towards the apices. Length 8.5 mm. Breadth 3.5 mm.

Head not as wide as the pronotum, rather sharply pointed; anterior and lateral margins of vertex red, black on the middle and posterior margins between the eyes. Eyes grayish black. Width at eyes a little longer than the length of the vertex. Face very tumid, the frons black with the carina red; numerous transverse furrows; clypeus bright red, rostrum long, black at the tip. Cheeks narrow, black.,with the edges red. Pronotum much wider than the head, the anterior margin straight, red; a large black transverse band behind the anterior margin, a median red band and the lateral edges red; posterior black; finely punctate and pubescent. Width about twice the length; length about one and a half times the length of the vertex. Sternum of thorax red. Scutellum very small, black, and very pubescent. Elytra bright red, the veins showing yellowish, towards the apical area lighter; hind wings brownish, paler towards the base, the veins brown, and red near the base. Abdomen above black, the posterior edges of the segments red; beneath black, red at base, and on edges of the segments. Genitalia of female red; the last ventral segment dark red, longer than the penultimate, and deeply emarginate. Legs dark red.

Habitat: Natal (Mansell Weale), Durban (Leigh, Oxford Mus.), Isipingo (Marshall), Delago Bay (Monteiro), Kaffraria (Stal), Cape Colony (Drege, Brit. Mus.), East London (Brain), Uitenhage (Oxford Mus.).

Locris rubida Stal.

Monecphora rubida Stal Ofv. Vet. Ak. Forh. 96. (1855).
Monecphora postica Stal Ofv. Vet. Af. Forh. 96. (1855).
Locris rubida Stal Hem. Afr. IV. 61. (1866).
Locris rubida Dist. Ins. Transv. IX. 228. (1866).

Color jet black, the elytra dark red, except the apical area. Black below. Length 10.5 mm. Breadth 3.5 mm.

Head very small, rounded anteriorly, the vertex black with a trace of red on the side margins before the eyes; length about equal to the width across the eyes, very pubescent. Face black, the frons very

tumid, with a median carina and numerous transverse furrows; a trace of red on the rostrum. Ocelli very small, eyes black. Pronotum strong, black, finely punctate, the lateral margins faint red, beneath black. Scutellum black, about one third the length of the pronotum, which is more than twice as long as the vertex. Elytra red, apices black. Hind wings smoky at apices, lighter towards the base. Abdomen above black, the posterior edges of the segments red; beneath black with red for the base and posterior edges of the segments. Female genitalia—last ventral segment not quite as long as the penultimate; pygofers rounded, short; ovipositor long. Legs black.

Habitat: Natal (Mansell Weale), Durban (Marshall), Kaffraria (Castelnau, Oxford Mus.), N. W. Rhodesia, Kambove (Neave), Cameroons (Escalera), Cape Province, Fort Beaufort (Brain).

Subf. Aphrophorida Stal.

Synopsis of Genera.*

A. Pronotum quadrangular.
Scutellum a little longer than broad: anterior margin at lobes of vertex acute: apices of elytra narrow ..... **Cordia**

AA. Pronotum sexangular.
Scutellum a little alonger than broad; anterior margin at lobes of vertex sulcate ..... **Philænus**
Scutellum much longer than broad; pronotum broader than the head. **Poophilus**

Genus **Cordia** Stal.

Head rounded or angularly rounded, with the anterior margin acute, at least to the lobes of the vertex. Front transversely striate. Lateral angles of the pronotum acute. Elytra suboblong, the apex a little narrow, and the lateral margins subparallel. At present this genus is only known from the Ethiopian Region (Distant).

Cordia peragrans Stal.

Cordia peragrans Stal. Hem. Afr. IV. 78. (1866).
Ptyelus peragrans Stal. Ofv. Vet. Ak. Forh. 97. 10. (1855).
Cordia peragrans Dist. Ins. Transv. IX. 223. (1908).

Grayish straw colored. Length 5.75 mm. Width 2–2.25 mm.

Head flat, brown in color, and covered with a fine gray pubescence, wider than the pronotum at eyes, and longer than half the length of the pronotum. Ocelli brown, as far apart from each other as from the eyes. Anterior margin of the head flat, rather sharp; two black spots on the face below the anterior margin of the head, and located midway between median sulcus and the antennæ. Face densely pubescent. Rostrum black. Eyes dark steel gray. Pronotum flat, twice as broad as its length, finely punctate, the punctations arranged in fine rugæ, very

*Adapted from Stal.

pubescent. Distinct longitudinal median line, on the pronotum, and two irregular impressions on the anterior half located behind the eyes; two more irregular marks, situated towards the median line, also on the anterior half. Scutellum brown, with gray pubescence, not quite as long as the pronotum. Sides of thorax brown. Elytra for the most part gray, brownish at the base; veins distinct brown; a black distal spot behind the middle, situate at the anastomosis of two cellular areas; apex of elytron almost transparent. Abdomen above dark brown to black, the margin lighter; beneath brown with a tinge of red; legs light brown, tips of tarsi black. Genitalia-female-last ventral segment short, notched at the middle; plates longer than last ventral segment, narrow; pygofers short and stout, with a distinct reddish tinge, very pubescent; ovipositor black, much longer than the pygofers.

Habitat: Caffraria (Stal), Cape Province (Stal), Transvaal Province (Distant), Zoutpansberg (Kaessner) and Selati River (Albany Museum).

Cordia albilatera Stal.

Cordia albilatera, Stal. Hem. Afr. IV. 79. (1866). Distant Ins. Transv. IX. 223. X. Tab. XXII. Fig. 9a. (1908–10).
Ptyelus albilatera Walk. List Hom. B. Mus. 723. (1851).

Grayish stramineous, covered with a pale down. Length 5.5. mm. Breadth 2 mm.

Head brownish not pubescent, a little wider than the pronotum at the eyes; vertex not quite as long as the pronotum. Ocelli closer to one another than to the eyes; anterior margin of head angularly rounded. Eyes long, wide, steel gray in color. Face a dark brown, darker than the vertex, pubescent; clypeus lighter in color, loræ brown, cheeks much lighter. Pronotum twice as wide as its length flat, finely punctate, pubescent, and rugose on the posterior half; anterior margin well rounded; faint irregular impressions on the anterior half, midway between the median line and the lateral margins. Scutellum much longer than broad, with a distinct whitish longitudinal ridge on the middle; apex sharply pointed. Elytra brownish, cinereous, very pubescent, the veins showing as dark brown ridges; apices well rounded, costal margin grayish; small black distal spot behind the middle situate at the anastomosis of two cellular areas; punctulate. Abdomen above black, the posterior edges of the segments and the lateral margins yellowish brown; beneath light brownish yellow. Male genitalia—last ventral segment rather short, slightly notched at middle; plates longer than the ultimate ventral segment; pygofers rather long, and narrow, the tips blackened. Legs light yellowish brown, the tips of the spines black.

Habitat: Transvaal, Zoutpansberg (Kaessner), Natal (Mansell Weale), Cape Colony (Stal), Grahamstown (Albany Mus.).

Genus **Philaenus** Stal.

Head angular, anterior margin of lobes of vertex obtuse, sulcate; apex of clypeus a little produced; rostrum two-jointed, reaching beyond the middle coxæ. Elytra oblong in general outline, the side margins subparallel, with the apices rounded.

This genus is widely distributed. In his work on the Transvaal forms, Distant includes Philaenus under Ptyelus.

Philænus caffer Stal.

Ptyelus caffer, Stal Ofv. Vet. Ak. Forh. 250. (1855).
id. Eug. Resa. Hem. 287. (1858).
Ptyelus caffer, Dist. Ins. Transv. IX. 221. (1908).
Philaenus caffer, Hem. Afr. 78. IV. (1866).

General color varies, usually a grayish straw or yellowish. Length 5-5.5 mm. Breadth 2 mm.

Vertex produced, rounded at apex, the disc flat, densely pubescent, the length longer than half the distance between the eyes and equal to about more than one-third of the width across the eyes. Frons swollen, convex, a little wider at the base than next the vertex, the sides subparallel, about twice as long as the width next clypeus; the latter is roughly triangular in shape, and sharply produced; loræ almost as wide as the clypeus, genæ angular; point of insertion of the antennæ dark brown; tip of rostrum black. Pronotum lighter in color than the head, covered with a grayish pubescence, with four blackish spots on the anterior half, two rather distinct, alongside the median line, and the other two indistinct, near the lateral margins. These spots, however vary in different forms. Anterior margin broadly rounded between the eyes; length a little longer than the vertex and longer than half the width of pronotum. Surface of pronotum finely punctate. Scutellum a little more than half the length of the pronotum. Elytra lighter than rest of the body, the veins distinct, showing as brown ridges, six apical cells, and three anteapicals, the middle cell of the latter shorter than the other two; apices rounded, a little narrower than on middle. Abdomen above brownish, beneath brownish black, in some cases pure black. Legs light yellowish. Genitalia—female; last ventral segment rather short, pygofers oval, broad, not as long as ovipositor. Male ultimate ventral segment twice as long as the penultimate, the posterior margin concave, plates a little longer than last segment.

Described from four males and one female.

Habitat: Cape Colony (Stal), Cape Province (Distant), Darling, C. P., (Mally).

Philænus hottentoti n. sp.

General color yellowish brown, form similar to P. caffer Stal, but a little stouter. Length 6 mm. Width 2 mm.

Head yellowish, broad; vertex angularly rounded, two black spots on the anterior margin, located on the middle close to one another; posterior

margin slightly convex on the middle, giving the ocelli a raised appearance; thin black transverse line on middle extending to margin of lobes. Eyes well rounded, whitish mingled with brown; ocelli dilute brown. Length of vertex less than half the distance between eyes, and equal to about one-fourth of the distance across the eyes. Face strong, of a yellowish color, covered with a dense grayish pubescence; frons distinct yellow, decidedly convex, traversed by numerous dark yellow arcs; two black spots near the margin of the vertex, in line with those on the vertex. Frons three times as long as its width next the clypeus and twice as long as the latter. Clypeus broad next the frons, strongly produced at the apex; loræ small, about one-third the width of the clypeus; genæ small, inwardly rounded; rostrum long, the last joint black. Antennæ deeply inserted, basal joint stout. Thorax well developed, darker in color than the vertex, finely punctate, and pubescent, twice as broad as long and two and a half times as long as the vertex; anterior margin angularly rounded, side margins short, rounded inwardly; posterior margin concave; scutellum longer than width at base, and half as long as the pronotum. Venter of thorax yellow except near the coxæ, where it is black. Elytra brownish, pubescent, the outer margins lighter; venation strong, of typical Philænus type. Abdomen above black, the margin somewhat yellow, beneath, brownish black, but possessing a grayish tinge owing to the pubescence. Legs a light yellowish brown. Genitalia—male last ventral segment a little longer than the penultimate, slightly concave on its posterior margin; plates long, about one and a half times as long as their width at base.

Described from one male.

Habitat: Cape Town. (Mally).

The above species may be distinguished from P. caffer Stal, by the darker color, the shorter vertex and the elytral venation.

Genus **Poophilus** Stal.

Head roundly subangular, disc of vertex flat, vertex narrower than the pronotum, the anterior margin acute; frons slightly convex; clypeus produced at apex, reaching beyond the fore coxæ. Ocelli almost as far from the eyes as from one another. Pronotum transverse, sixangled, the lateral margins short, and the anterior broadly rounded. Scutellum longer than broad. Elytra densely punctate, apical area narrower and rounded, the side margins straight as far as the apex.

Poophilus terrenus Walk.

Ptyelus terrenus Walker List Hom. Brit. Mus. III. 709. (1851).
Ptyelus umbrosus Stal Ofv. Vet. Ak. Forh. 97. (1855).
Poophilus umbrosus Stal Hem. Afr. IV. 74. (1866).
Poophilus terrenus Dist. Ins. Transv. IX. 222. (1908).

Color tawny brown. Length 10 mm. Breadth 3.25 mm.

Vertex strong, the anterior margin sharp; length not quite equal to the width between the eyes; ocelli colorless, closer to one another than to the eyes. Eyes oval, elongate, brown, prominent; anterior of head rounded. Face strong, black, interspersed with yellowish spots on the margin, slightly convex, flat on middle, with numerous transverse furrows; frons with some yellow irregular spots; clypeus yellowish, long, produced, heart-shaped, about two-thirds of the length of the frons; rostrum long, black at the tip; loræ long, very narrow; cheeks narrow next the loræ wider beneath the eyes. Pronotum dull brown, the anterior margin broadly rounded, side margins very acute, posterior somewhat concave; flat on top, with two small depressions alongside the median line; length of pronotum greater than the vertex, the breadth about twice the length. Scutellum much longer than broad, the apex sharp; venter of thorax black, the pro-, meso-, and metapleura with yellow borders. Elytra dull brown, with many irregular black markings, the margins lighter; venation distinct, apex of elytra sharply rounded. Abdomen yellow beneath, with black for the base. Legs yellowish with brown spots. Genitalia—female; last ventral segment not quite as long as the penultimate; pygofers yellow, broad, flattened, twice as long as their width at base; ovipositor brown, sharp, a little longer than the pygofers.

Habitat: Transvaal, Pretoria (Swiestra), Lydenburg, (Krantz), Zoutpansburg (Kaessner), Johannesburg (Fry), Water val-onder (Ross), Natal, Durban (Mansell Weale), Isipingo (Marshall), Delagoa Bay (Junod), Kaffraria (Stal), Wynberg, C. P., (Mally).

Superfamily Jassoidea.

The members of the Superfamily Jassoidea may be recognized by the character of the tibiæ, which are prismatic in shape, and armed with a row of spines on their posterior margins.

Synopsis of Families.

The following key, taken from Osborn's work on the Jassoidea of Maine, will illustrate the main characters of the subfamilies.

A. Elytral nervures forking on the disk.
  b. Ocelli located on the disc of the vertex..... **Tettigoniellidæ**
  bb. Ocelli located on border of vertex between vertex and front.. **Jassidæ**
  bbb. Ocelli located on front distinctly below border of vertex.... **Bythoscopidæ**

AA. Elytral nervures forking at base and running to apex of elytra, ocelli usually wanting..... **Typhlocybidæ**

Besides the works of Walker and Distant, the more important publications on the South African forms are those of Melichar, Signoret, Distant and Burmeister.

FAMILY BYTHOSCOPIDÆ.

The general characters of this family are well marked, the most conspicuous being the position of the ocelli, which are located on the front below the vertex. As a rule the vertex is short and wide, and with the eyes, is generally or often broader than the pronotum. Definite striations are frequently observed on the pronotum. The elytral venation is frequently obscure. The appended synopsis of genera will indicate the main characters of the genera.

Like the Typhlocybidæ, little is known about the South African representatives of this family. The writer is fortunate in being able to describe a member from each of four of the most prominent genera.

SYNOPSIS OF GENERA.*

A. Antennae inserted in a deep cavity beneath a ledge.
  b. Striation of the pronotum transverse.
    c. Side margins of the pronotum sharply keeled, of moderate length..... **Macropsis**
  bb. Striation of pronotum running obliquely from the middle of its front margin to the hinder angles.....**Pediopsis**
AA. Antennae inserted in a feeble cavity, their base free.
  b. Head with the eyes wider than the elytra at the base, membrane with an appendix.....**Idiocerus**
  bb. Head with the eyes as wide as the elytra at base, no appendix..**Agallia**

Genus **Macropsis** Lew.

Macropsis subolivaceus Stal. (Pl. IV, Fig. 1).

Bythoscopus olivascens, Stal. Ofv. Vet. Ak. Forb. I. 99 (1855).
Macropsis subolivaceus, Stal. Hem. Afr. IV. 127. (1866).
Macropsis subolivaceus, Mel. Beit. Z. Kenn. Hom. Deutch Oost-Afrika 297. (1905).

General color olivaceous. Length, 5 mm. Breadth, 2 mm. Vertex yellow, very short; well rounded anteriorly and distinctly striated. Eyes steel gray, small; width between the eyes four times as long as the vertex. Face short, two-thirds as long as its width across the eyes; frons yellowish. Clypeus greenish, one and one-half times as long as its breadth; loræ prominent, not quite as wide as the clypeus. Ocelli colorless or sanguineous. Pronotum yellowish green, with strong transverse striations on its posterior half, and smaller striations on the middle of the anterior half, but not reaching the margin; about three times as long as the vertex, and about half as long as the width of the pronotum; anterior margin well rounded, the lateral margins of moderate length; posterior half broader than the anterior, being the widest part of the body; convex anteriorly and laterally. Scutellum a little longer than broad tapering to a point; about as long as the pronotum; olivaceous in color, but with two large brown spots at the basal angles, and a

*Adapted from Osborn.

curved depressed line on the middle, behind which are pronounced transverse striations. Elytra yellowish green, with a fine punctation; transparent; venation indistinct, some of the veins being indicated by minute papillæ; appendix well developed. Abdomen above yellowish, beneath greenish. Legs greenish, posterior tibiæ very strong. Genitalia—female; last ventral segment more than twice as long as the preceding, convex, with the posterior margin very slightly concave; pygofers strong, about three times as long as the last ventral segment, convex laterally; widely separated on the middle, and narrowing at the tip; ovipositor equaling the pygofers in length. Male—last ventral segment about three times as long as the penultimate, strongly produced to a rounded point pygofers rounded, not as long as the ultimate ventral segment.

The nymphs of this species are dull, greenish brown in color, covered with numerous fine hairs or spines, and have a broadly oval appearance. The vertex is longer than in the adult, while the pronotum is rectangular. The body is large, rounded and very hairy.

Habitat: Cape Town (Mally), Rondebosch (Stal), Sierra Leone (Stal), Tanga (Melichar).

Genus **Pediopsis** Burm.

Pediopsis capensis sp. n. (Pl. IV, Fig. 2).

Form broad and stout, general color greenish yellow, covered with a fine brown spotting. Propleura with a black spot. Length 4.5 mm.; width at pronotum 2 mm.

Vertex very short, viewed from above, narrow at middle, but becoming slightly wide towards the eyes; greenish in color, with the brown spots rather obscure. Eyes steel gray, a little wider than the pronotum, having a flattened oval appearance. Face yellowish green, broad and of moderate length, with coarse though shallow rugulæ and punctulations; frontal suture prominent; frons strong, wide between the eyes; tapering gradually to the clypeus; the latter short, broad, and prominent, wider next the frons than at apex; loræ long and narrow; cheeks of moderate width, slightly depressed beneath the eyes; ocelli colorless. Pronotum olivaceous, with brown spots, prominent; rugæ conspicuous, decidedly oblique; anterior margin broadly triangular, lateral of moderate length, posterior slightly concave; length about two-fifths of the breadth; disc convex on posterior half. Scutellum large, of a yellowish color, with two large, round brown spots located at the basal angles, about equal to the pronotum in length; a short transverse line on the posterior half. Venter of thorax yellow, black spots on the pro- and metapleura. Elytra yellowish, with numerous brown spots; at apex of the clavus are two brown markings, which when the wings are at rest, give a distinct spot, different from the general marking. Venation distinct, six closed cells on the corium, one basal, two discal, and

three anteapical; membrane composed of fine apical cells. Wings very delicate, membranous, the supernumerary cell absent. Abdomen above greenish, short, compressed, beneath yellowish. Legs brownish, tarsi three jointed, the basal joint almost as long as the second and third combined. Male genitalia; last ventral segment twice as long as the penultimate; plates as long as the ultimate ventral segment.

Described from two males.

Habitat: Cape Flats, C. P., (Mally).

Genus **Idiocerus** Lewis.

Idiocerus hewitti. sp. n. (Pl. IV, Fig. 3).

Yellowish green, with two black spots on the anterior margin of the vertex and two spots, also black, on the base of the scutellum. Length, 5.5 mm. Width across eyes 2.25 mm.

Vertex broad and stout, with the eyes very prominent, greenish in color; yellow halos around the black spots, which are situated nearer the eyes than the median line. Eyes very large, brownish black; ocelli colorless, located nearer the eyes than the middle. Face broad, a little broader than its length; frons large, convex, yellow with lighter transverse bands on the middle; clypeus a little larger than its breadth; loræ prominent; cheeks somewhat lighter than the rest of the face. Pronotum long, with distinct transverse striations. Scutellum yellow, a little longer than the pronotum, with two round black spots on the base. Elytra faint yellow, with the venation rather indistinct; apical cells prominent the sectors set with minute tubercles. Abdomen above black, beneath greenish yellow; lateral margins green. Legs light yellow to whitish. Female genitalia: dull green in color, the last ventral segment, more than twice as long as the penultimate, notched at the middle, and slightly concave on its posterior lateral margins; pygofers large, stout, shorter than the ovipositor, which is broader at the tip, than at base.

Habitat: Grahamstown, C. P., (Hewitt).

The above species was described from two females sent to me by Mr. J. Hewitt, Director of the Albany Museum, at Grahamstown.

Genus **Agallia** Curtis.

Agallia nigrasterna sp. n. (Pl. V, Fig. 1).

Form similar to A. novella Say. Color light yellowish brown, the elytra whitish. Length of male almost 4 mm. Breadth 1.25 mm.

Vertex yellow, brownish on the middle, short, about one-fourth of the length of the pronotum; two large, round, black spots on the anterior margin; and two faint fuscous bands on the middle, between them; width of vertex across eyes greater than the pronotum. Face brownish

white, the frons brownish on the middle and sides, with a brown band extending from below the ocelli to the anterior margin of the head; much wider than the clypeus, which is oval in shape, yellowish, with the sides marked brown; loræ white, not as wide as the clypeus. Cheeks white, strong and broad. Ocelli colorless. Black markings beneath the antennal pits. Pronotum strong, brownish on anterior, whitish on posterior half with two large black spots near the posterior margin; irregular brown markings in advance of these, and a brown median band. Pronotum almost twice as wide as its length, the anterior margin rounded, and the posterior broadly rounded towards the sides; convex above. Scutellum yellow, with a brownish semi-circular furrow on the anterior half, not as long as the pronotum; apex tapering to a fine point. Thorax beneath black. Elytra gray, semi-transparent, the veins distinct, showing as brown lines. Middle anteapical cell much larger and longer than the other two; only three apical cells present. Abdomen above yellow, black at the base, beneath light yellow. Legs light yellow to whitish. Genitalia: male—last ventral segment a little longer than the previous ones; valve strong, three times as long as the ultimate ventral segment, broadly triangular in shape, rounded at apex; plates triangular, about equalling the valve in length. Pygofers not as long as the plates, yellowish ventrally, black dorsally.

Described from two males.

Habitat: Cape Town (Mally).

This species may be easily distinguished from A. novella Say. by the size and shape of the pronotum. In the former the pronotum is much larger and more convex than in the latter. Further the black spots on the pronotum of A. novella are located nearer the middle than in this species.

Agallia cuneata sp. n. (Pl. V, Fig. 2).

Form thin and slender with the posterior end of the body distinctly wedge-shaped. Color light pink, obscured in parts by a white incrustation; large round, black spots on vertex and pronotum. Length 3.5 mm. Breadth scarcely 1 mm.

Vertex small, well rounded, pinkish, the black spots on the anterior margin surrounded by yellowish halos; length about one-fourth as long as the pronotum; anterior margin rounded. Eyes yellowish, ocelli black Face narrow, a little longer than broad; frons whitish, with brown across the middle, and on the sides to the clypeus; genæ almost straight margined from clypeus to the eyes; loræ rather long and narrow, not as wide as the clypeus, which is short and oval, its length about one-fourth of the frons; sutures marked indistinctly with brown in parts. Pronotum whitish pink, about one and a half times as broad as its length, and not as wide as the vertex across the eyes; convex above both anteriorly and laterally; anterior margin rounded between the eyes, side margins of

moderate length; two black spots near the posterior margin, large and round. Scutellum whitish, about as long as the pronotum. Pro-, meso- and metapleura black. Elytra covered with a whitish incrustation, venation distinct, the veins indicated in part by brownish lines; apex of elytron rather sharply rounded. Four apical cells, and two ante-apicals, the inner ante-apical being much larger and longer than the other. Abdomen above blackish gray, the borders and ventral surface yellow. Legs dirty white. Genitalia: female—last ventral segment about one and a half times as long as the penultimate, the posterior margin almost straight, except for a small niche on middle; pygofers about two and a half times as long as the last ventral segment, and longer than their width at base; ovipositor longer than pygofers, black at the tip.

Described from one female.

Habitat: Cape Town, C. P. (Mally).

FAMILY TETTIGONIDÆ.

The family Tettigonidæ is easily recognized by the position of the ocelli which are located on the disk of the vertex.

Subfamily Gyponinæ Berg.

Genus **Penthimia** Germ.

Body oval; head obtuse, the anterior margin rounded. Pronotum frequently longer than the vertex, sometimes transversely striated. Scutellum a little broader than long.

Penthimia bella Stal.

Penthimia bella Stal. Hem. Afr. IV. 108. (1866).
Penthimia bella Stal. Ofv. Vet. Ak. Forh. 98. 2. (1855).

General color from above black intermixed with brown and dirty white, beneath black and brown. Length of female 4.5 mm. Breadth 1.75 mm. Vertex yellowish white with irregular brown markings arranged along a median line; obtusely angular, the length not as great as the width of the head between the eyes; anterior of head sharply rounded. Ocelli brown, eyes black. Face black, except the brown clypeus; sutures distinct; clypeus small, about one-fourth of the length of the frons. Pronotum a mottled brown, black and white; longer than the vertex, slightly convex on the anterior half, the lateral margins rather short. Scutellum yellowish with brown markings at the basal angles, about two-thirds as long as the pronotum. Elytra whitish but with a mottled appearance due to the brown and black; a few clear spaces in the anteapical cells, some hyaline areas on the corium, and middle of costal margin. Abdomen above brownish, lighter ventrally with the borders yellow. Genitalia: female—pygofers large, yellow with bluish marks, convex and very spiney; last ventral segment more than

twice as long as the penultimate, inwardly rounded on the posterior margin, and slightly produced on the middle; ovipositor large, longer than the pygofers.

Habitat: Rondebosch, C. P. (Stal: Mally).

Penthimia vinula Stal. (?)

Penthimia vinula Stal. Hem. Afr. IV. 108. (1866).
Penthimia vinula Stal. Afr. Vet. Ak. Forb. 98. 2. (1855).
Penthimia vinula Distant. Ins. Transi.

Form and appearance of P. bella Stal. Color shiny black mingled in parts with brown and white. Length 4 mm. Breadth 1.75 mm. Vertex white but with black markings which are symmetrical along a median line; length not equal to the width between the eyes; convex anteriorly, the margin obtuse. Eyes large, chocolate colored, ocelli black. Face strong, the frons prominent, about three times as long as the clypeus; loræ about as wide as the clypeus; cheeks large; two large prominent white spots on the face above the region between the eyes. Pronotum black with many small white spots; a little longer than the vertex. Pronotum and vertex transversely striated. Scutellum black over the major part, with a few white spots at the base, a white spot at the apex, and two large brown marks on the middle. Elytra fuscous black; claval area with few white spots; corium with a clear area near the base of the costal margin, a circular clear space at the apex of the claval suture and three distinct clear spaces on the area of the anteapical cells. Abdomen brownish black above, black on the venter, the edges of the segments showing as white lines and the margin a little lighter than the remainder. Male genitalia: last ventral segment black on the middle, yellow at the borders, about equal to the penultimate in length; valve yellowish brown, not as long as the ultimate ventral segment; plates black, longer than the valve, the tips sharp; pygofer longer than the plates, black.

Habitat: Cape Town (Mally), Transvaal, Pretoria (Distant), German East Africa: Amani, Bomole (Melichar).

This species varies from the P. vinula figured by Distant, in having white on the vertex, pronotum and middle of the elytral disk.

FAMILY JASSIDÆ.

The true Jassids are characterized by the position of the ocelli, which are located on the anterior margin of the vertex where it merges into the frons. The appended synopsis of tribes, taken from Van Duzee, best illustrates the main characters.

The family is perhaps better known than any other of the Jassoid division and the number of described species is far in excess of the Bythoscopidæ and Typhlocybidæ.

Synopsis of Tribes.

Anterior edge of the head thin and sharp, or more or less foliaceous....**Dorydini**
Anterior edge of the head sometimes acute, but generally obtuse or rounded, never thin and foliaceous.....**A.**
A. Elytra with two transverse nervures between the first and second sectors of the corium.....**Deltocephalini**
Elytra with but one transverse nervure between the first and second sectors of the corium.....**B.**
B. Elytra without a series of anteapical areoles or with but one, formed by the forking of the outer branch of the first sector; vertex subquadrate, the hind and lateral margins elevated, before feebly arcuated, with the edge strongly rounded or produced and tumid before with an obtuse apex.....**Jassini**
Elytra with a series of (generally three), apical areoles.....**C.**
C. Outer branch of the first sector of the elytra with two forks evident.....**Athysanini**
Outer branch of the first sector of the elytra with its outer fork obsolete or nearly so, anterior edge of the head well rounded, vertex but little, if at all longer on the middle than next the eye.....**Cicadulini**

Tribe Dorydini.

Genus **Cephalelus** Perch.

Cephalelus—Percheron in Guer. Mag. Zool. ii, Classe IX, (1832).
Dorydium—Burm. Handb. Ent. ii, 1, 106, (1839).
Burm. Gen. Quaedam. Insect i, (1838).
Cephalelus—Signoret, Ent. Soc. Fr. 504, 259, (1879).
Kirby, Trans. Ent. Soc. Lond, 412, (1894).

Head long, narrow, very strongly produced; vertex long, pointed, the sides rounded, more than three times as long as the width, face large, merging into the vertex; clypeus heart-shaped. Eyes lateral, elliptical. No ocelli. Antennæ short, the basal joint large and cylindrical, the second long, the third subcylindric. Pronotum transverse, the lateral margins of moderate length. Elytra corneous, punctulate, the apices rounded. Tibiæ without spines. Abdomen elongate, the males much shorter than the females.

Cephalelus infumatus Perch. (Pl. VI, Fig. 1).

Cephalelus infumatus Perch. in Guer, Mag. Zool. ii. Classe IX. pl. 48. (1832).
Dorydium paradoxum Burm. Handb. Ent. ii. 106. (1839).
Cephalelus infumatus Walk. Cat. Hom. Brit. Mus. 637. (1851).
Cephalelus infumatus Amy. & Serv. Essai sur les Jassides. 258. (1878).
Distant Ins. Transv. X. 241. (1910).

General color dark red to brown or yellowish brown in dried specimens. Length of females 11.75 mm. to 12.75 mm. Average length of twelve females 11.95 mm. Length of males 9.25 to 10.25. Average length of thirteen males 9.35 mm. Breadth 1.5 mm.

Female—Head dull red to brown above, with an indistinct line along the middle of the vertex, extending from the anterior margin, to a little before the eyes; beneath dark red with a broad yellowish band running along the middle, rather narrow at the anterior, but widening towards the posterior margin. Vertex about four times as long as its breadth;

with two dull red spots a little in advance of the eyes; finely punctate, and about five times the length of the pronotum. Eyes dark green to black, rather large. Ocelli absent, but two small depressions are indicated, where one would expect the ocelli. In his original description Percheron noted the presence of ocelli, but later Burmeister drew attention to the fact that these were mere depressions. Antennæ short, sharp at the distal end, inserted in deep pits. Facial sutures distinct; genæ yellowish, rounded; clypeus large, a little longer than broad, tapering gradually to the rostrum. Pronotum red, darker at the sides; a longitudinal line along the middle. Scutellum shorter than the pronotum. Elytra dark red, broadly oval in shape, densely punctulate, the punctation arranged in definite series; shorter than the abdomen. Abdomen above red, beneath light brown to yellowish. Genitalia: last ventral segment small and distinctly notched and grooved on the middle, not as long as the penultimate; pygofers long and narrow, widely separated at the base, becoming closer on the middle, and separating again at the tip. Ovipositor long, thin, much longer than the pygofers, its length about 3.5 mm. Legs light brown, the femurs stout.

Male—Face with a distinct yellow band along the middle; elytra much longer than the abdomen, light brown along the margin of the corium. Genitalia, last ventral segment not quite as long as the penultimate, valve about as long as the last ventral segment, triangular in shape; plates long, rounded at the tips, about twice as long as the valve; pygofers a little shorter than the plates.

This interesting insect is one of the most unique in Southern Africa. According to the literature it seems to be scarce in collections, but in the material on hand it is quite abundant. The original description was based on a single specimen, the habitat of which was unknown until later it was identified with the Cape. Burmeister stated that he had only seen two specimens, one at Berlin and the other at Hamburg, and he mentions the habitat as the Cape of Good Hope. As far as the writer is aware, this is the only complete description of both male and female that has been published.

An interesting case of protective mimicry is recorded for Cephalelus infumatus, and this probably accounts for its scarcity in collections. According to Professor Osborn, "The protective feature comes in from the fact that the aborted leaf-sheaths on the stem of the plant form sharp spines occurring at intervals along the length of the stem, and these are perfectly reproduced in the form and color of the insect. So close is the resemblance that when a number of the spines are mounted separately alongside of the insects, it is very difficult to distinguish them without the most careful scrutiny. When the specimens were first received, I had looked them over some time before noticing that a number were not insects at all, but simply spurs and had there not been one mounted with a fragment of stem along with an insect beside it, I might have taken a much longer time to make the discovery. I have shown the set to a number of individuals, who have taken quite a little time to make the same discovery."

"According to Mr. Mally the insect lives on the rush Dovea tectorum Masters, the spurs of which are mimicked. I may mention that the stems are green, while the aborted leaf-sheaths are dark brown."

Tribe Deltocephalini.

Genus **Deltocephalus** Burm.

Body oblong or oval, elongate; head with the eyes as wide as the pronotum, pointed in front; ocelli on margin between vertex and front. Vertex flat or slightly convex at the lateral margins, more or less angularly produced in front. Inner sector of elytra forked twice, three anteapical cells present. In the Brachypterous forms there is a decided reduction in the number of veins.

Deltocephalus breviatus sp. n. (Pl. VI, Fig. 2).

General color yellowish green, Brachypterous form. Length 2.75 mm. Breadth scarcely 1 mm.

Male—Vertex yellow, with a median line extending from the posterior margin to a little beyond the middle; length a little more than twice the width between the eyes; anterior margin sharply pointed, acutely rounded; eyes greenish white, large, prominent, extending backward beyond the anterior edge of the pronotum. Ocelli small, colorless, located near the eyes. Face yellow, the frons traversed by six to eight brown arcs; length of entire face about equal to the width across the eyes; frons more than twice as long as its width next clypeus, and more than twice as long as the clypeus, which is one and one-half times as long as it is broad and is parallel margined. Loræ prominent, cheeks broad and strong. Pronotum greenish-yellow above, black beneath; broad, not as long as the vertex, the anterior margin rounded between the eyes. Scutellum small, yellowish green, half as long as the pronotum. Elytra yellowish, transparent, short, extending to the penultimate dorsal segment of the abdomen; venation rather indistinct, apices of elytra broadly rounded. Abdomen above yellowish, the first two segments black on their lateral margins; beneath black, with yellow borders. Legs light yellowish, the coxæ black. Genitalia; last ventral segment very small, less than half as long as the penultimate; rounded broadly on its posterior margin, black on the anterior, and light yellow on the posterior; valve black, more than twice as long as the last ventral segment, rounded at its apex; plates long triangular, yellow, with occasional black spots, tips rounded. Pygofers large, longer than the plates, very spiny, the spines forming a crown at the tip; ventral color black at base, yellow at the tip; dorsal yellow, but black at the bases of the lateral margins and the tip black.

Female—General color the same as the male. Head somewhat sharper and more pointed. Genital apparatus, last ventral segment black, a little larger than the penultimate, sinuate on the middle, the posterior margins curving slightly to the sides; pygofers yellowish, more or less colored with brown and black, widely separated at the base, but converging towards the tip; the amount of brown coloration of the pygofers varies but as a rule is confined to the basal half; ovipositor

black, strong, equaling the pygofers in length; ventral tip of pygofers black, the spines strong, forming the crown as in the male.

Described from three females and seven males.

Habitat: Cape Town, C. P. (Mally).

Deltocephalus aristida sp. n. (Pl. VI, Fig. 3).

General color brownish black. Form long and slender. Length of female 4 mm. Breadth scarcely 1 mm.

Head brownish black, prominent; disc of vertex flat, slightly rounded towards the sides, the apex very pointed; a median line extending from the posterior margin to the tip of vertex; length greater than the width and equal to about half the width across the eyes. Face strong, longer than its width; frons black with faint yellowish arcs, three times as long as its width next to clypeus, and two and one-half times as long as the latter; clypeus black, with a faint yellowish tinge, one and a half times as long as its width next to the frons, sides almost parallel, apex rounded; loræ prominent, half as wide as the clypeus; genæ well rounded, depressed beneath the eyes, black with a narrow yellow border. Point of insertion of the antennæ deep. Face, vertex, prothorax and scutellum finely punctulate. Pronotum well rounded between the eyes, black with five indistinct yellowish longitudinal lines, one on the middle and two on either side, near the lateral margins; posterior margin slightly concave, lateral margins somewhat convex, short; length of pronotum not quite as long as the vertex; sides and venter black with a bluish tinge. Scutellum black, about equal to the pronotum in length. Elytra brownish, becoming lighter at the apex of the corium; veins showing as lighter lines; appendix strong; abdomen above blackish brown, beneath black; legs lighter in color than the rest of the body. Genitalia, Female—ultimate ventral segment about twice as long as the previous, strongly produced on the middle, the posterior margin rounded, inwardly, the apex somewhat convex; pygofers strong, widely separated at the base, and closer near the tip, three times as long as the last ventral segment; color brown with a yellowish tinge; ovipositor wide, a little longer than the pygofer.

Described from one female.

Habitat: Cape Town, C. P. (Mally).

Tribe Athysanini.

Genus **Athysanus** Burm.

Body robust, somewhat rounded at the sides. Head with eyes generally wider than the pronotum, obtuse in front. Vertex slightly produced; ocelli located near the eyes on the margin between vertex and front. Pronotum short, transverse, sometimes striated. Elytra with inner sector forked twice, three anteapical cells and frequently five apicals. Ovipositor short, little if any longer than the pygofer.

Athysanus capicola Stal. (Pl. VII, Fig. 1).

Thamnotettix capicola Stal Hem. Afr. IV. 123. (1866).
Athysanus capicola Stal. Ofv. Vet. Ak. Forh. 99. 2. (1855).

General color yellowish or dirty white. Length of male 5 mm., female 5.5 mm. Breadth 1.75 mm.

Vertex rather short, not produced, whitish in color with a strong black or brown transverse band across the middle; prominent and running from eye to eye; length of vertex about equal to one-half times the width between the eyes; anterior margin of the head obtusely rounded, the lateral margins sloping, slightly convex on disc with rather indistinct striations. Eyes dull green, large. Ocelli located nearer the eyes than to the middle, dilute red. Face strong, yellowish, with many dark yellow transverse arcs on the frons; frons a little longer than its breadth, much wider than the clypeus, and about two and a half times as long. Cheeks and loræ lighter in color than the frons, the latter as wide as the clypeus; clypeus produced, twice as long as its width, the sides subparallel and the apex rounded; rostrum rather long. Pronotum dilute yellow with numerous small brown spots; an irregular row of brownish spots on the anterior half arranged transversely; length of pronotum greater than that of the vertex; width more than twice the length. Scutellum yellow, not quite as long as the pronotum, transversely striated at the apex. Elytra equaling the body in length, overlapping at the tips; color yellow, the veins showing as brown lines. Appendix strong. Abdomen above yellow, with small black spots on the lateral margins of each segment; beneath yellowish in females, brownish in males. Legs light yellow to whitish. Genitalia female: last ventral segment more than twice as long as the penultimate, notched at the middle, convex on the surface; pygofers long and slender, about two and a half times as long as their width at base, and three times as long as the last ventral segment; ovipositor strong, longer than the pygofers, sharp at the tip. Male: last ventral segment, a little longer than the previous one, brownish black in color; valve a little longer than the last ventral segment, plates narrow somewhat rounded at the tip, about twice as long as the valve; pygofers not quite as long as the plates.

This jassid is by far one of the most common in Southern Africa and has been taken in great numbers on grasses and forage crops in the Eastern Province of Cape Colony. It is undoubtedly of some economic importance, not only on account of its numbers, but on account of its wide distribution throughout the provinces. It exists under a variety of different conditions, ranging from tropical, through subtropical to temperate regions, judging from the fact that it has been taken commonly in German East Africa, the Island of Mauritius, Senegal, Natal and the southernmost portions of the Cape.

It is closely related to Athysanus exitiosus, a form which is most common and of great economic importance in the United States. Morphologically the two agree in many characters, and show similar variations. The North American form is undoubtedly a tropical one, which has gradually migrated from Central America to the north, its food habits changing with time and the propagation of cereal crops. Similarly the African form is probably of tropical ancestry, and has gradually spread from the equator southward till it reached the coastal region. The cases are parallel in point and are of interest on that account. While it may seem a far stretch of imagination to consider a common ancestry for the two species, yet such a conjecture would seem feasible, in view of the land connection which once existed between Africa and South America.

Habitat: Rondebosch, C. P. (Stal), Cape Town (Mally), Grahamstown (Cogan), De Aar, C. P. (Cogan), Mauritius (Stal), German East Africa, Amani, Sigital, Tanga, Bomole, Kiboteni (Melichar).

Athysanus æthiopica sp. n. (Pl. VII, Fig. 2).

General color greenish white, with a varying amount of brown or black on the face. Length 3. mm. Breadth about 1 mm.

Female: Vertex whitish with an irregular black marking at the apex, not quite as long as the width between the eyes; ocelli colorless, eyes greenish. Face yellow, but prominently marked with black; frons yellowish white, except for the strong black arcs, about twice its length next the clypeus; loræ yellow with the sutures brown to black; cheeks yellowish green; clypeus one and a half times as long as its width next the frons, yellow with brown on the middle; rostrum brownish black. Pronotum greenish, broadly rounded between the eyes, a little shorter than the vertex, faintly transversely striated; scutellum yellowish, not quite as long as the pronotum. Sternum black. Elytra a little longer than the abdomen, semi-transparent, light greenish white in color. Abdomen above black with the borders yellow, beneath yellow but with black for the base and the middle. Genitalia: last ventral segment whitish, more than twice as long as the penultimate; posterior margin slightly curved inward and produced on the middle; pygofers long and slender, two and a half times as long as their width at base; ovipositor brown at the tip, a little longer than the pygofers; ovipositor brown at tip, a little longer than the pygofers.

Male: General color the same as female; the brown coloration is perhaps more prominent on the males. Black marking on the vertex not as evident. Abdomen entirely black on dorsal and ventral sur-

faces. Genitalia: last ventral segment black on middle, yellow at the sides; little longer than the penultimate; valve black at base, yellow on border, scarcely visible; plates whitish long, somewhat rounded at the tips; pygofer a little longer than the plates. Legs light yellowish white.

Described from four males and four females.

Habitat: Cape Town (Mally).

The species described above is subject to some variation in the distribution of the brown coloration of the face, vertex and abdomen. In some, the black marking on the vertex is absent, in others very prominent; in others the black on the face extends all over except for the middle of the frons and cheeks and loræ, while it may be wanting in some other specimens.

Athysanus eriocephalus sp. n. (Pl. VII, Fig. 3).

General color light yellowish to brownish. Length 4 mm. Breadth 1.5 mm.

Female—Color yellowish brown, with the vertex a dirty white, marked with irregularly shaped brown markings. Head strong, the vertex somewhat produced, with the anterior margin rather sharp, and the apex angular; length of vertex a third greater than the pronotum, and less than the width between the eyes, equalling about two-fifths of the total width across the eyes. Eyes black, prominent; ocelli located near the eyes. Face strong, the frons marked by numerous transverse brown arcs, about one and a half times as long as its width a little above the clypeus; the latter about one and a half times as long as its breadth, the margins subparallel; frons about two and a half times as long as the clypeus; loræ not quite as wide as the clypeus. Pronotum a dirty white with brownish markings, narrow, about three times as wide as its length, the anterior margin broadly rounded, the lateral margins short. Scutellum not quite as long as the pronotum. Elytra yellowish white, with occasional brownish spots, veins showing as brown lines; brown spots on the middle anteapical cell, the first discal cell, and two on the second discal cell; margins well rounded. Abdomen above brownish black, beneath brownish yellow. Genitalia, last ventral segment about one and a half times as long as the penultimate; posterior margin deeply emarginate, color yellow, the pygofers brownish, much wider at the base than the tip. Ovipositor blackish, strong, a little longer than the pygofers.

Male—Lighter than the female, in fact a light straw color; elytra lighter, otherwise resembling the female. Genitalia: Last ventral segment brown on the middle, whitish yellow at the sides, almost one and a half times as long as the penultimate; valve small, semicircular, scarcely visible; plates yellowish brown, almost as long as last ventral segment; pygofer a little longer than the plates.

Described from two females and five males.

Habitat: Cape Town (Mally).

Athysanus cyclopia sp. n. (Pl. VII, Fig. 4).

General color dull brownish, with the elytra bluish gray; form short and broad. Length 3 mm. Breadth 1.25 mm.

Vertex brown, flat on the disk, the apex pointed and the margins sloping; small brown lines fringing the anterior margin running from the apex to the eyes; these arcs are continued over on the face. A small median line running from the middle of the posterior margin to the middle of the disk; length not equal to the width between the eyes, and about one-third of the width across the eyes. Ocelli colorless; eyes brown. Face yellowish brown, with brown arcs on the frons; rostrum dark brown. Frons large, rather swollen near the vertex; clypeus one and a half times as long as its breadth; loræ almost as wide as the clypeus. Pronotum grayish brown, with indistinct brown marks behind the eyes, about two-thirds of the length of the vertex; anterior margin broadly rounded; lateral margins very short; scutellum with two faint black marks on the middle, about two-thirds of the length of the pronotum; sternum and metapleura whitish yellow. Elytra with fuscous marks on the middle of the claval area; small black spot at apex of claval suture; corium with brownish marks on the middle, the anteapical cells marked with brown, and the costal margin before the apical cell black; elytra not as long as the abdomen; venation reduced. Abdomen above brownish yellow, beneath yellowish with brown for the middle and base. Female genitalia: Last ventral segment one and a half times as long as the penultimate, the posterior margin deeply concave; middle of posterior margin brown; pygofers three times as long as the last ventral segment, widely separated on the middle and converging to the tip of the ovipositor, not as long as the ovipositor; the latter strong, brown with sides black. Legs dull yellowish with the spines brown.

Described from one female.

Habitat: Cape Town (Mally).

Athysanus nemesia sp. n. (Pl. VIII, Fig. 1).

Brachypterous form. Color yellowish, faded. Length, 3.5 mm. Breadth 1.25 mm.

Vertex light yellow, flat on disc, sloping at sides; width between the eyes a little longer than the length of the vertex, anterior margin angularly rounded; eyes grayish, large, prominent; frons much wider than the clypeus and about two and a half times as long, whitish in color and traversed by numerous yellowish brown arcs; clypeus rather long, twice as long as its breadth, angular at apex; loræ narrower than the clypeus. Point of insertion of the antennæ surrounded by a brownish marking. Pronotum more than twice as broad as long, and shorter than the vertex, yellowish in color, lighter on the anterior half, the posterior half distinctly transversely striated; anterior margin broadly rounded, the lateral margins short; scutellum equalling the pronotum in length. Sternum yellow, dorsal surface lighter. Elytra with the venation distinct, but reduced, much shorter than the abdomen.

Genitalia: Male—last ventral segment not quite as long as the penultimate; plates roundly triangular, a little more than twice as long as the last ventral segment, and longer than the pygofers. Legs a dirty white.

Described from one male.

Habitat: Cape Town (Mally).

Genus **Thamnotettix** Zett.

Body oblong or oval, widest in the middle. Pronotum strongly curved in front, the side margins short. Head usually short. Scutellum generally as long or not quite as long as the pronotum. Elytra longer than the abdomen and overlapping at the apex.

This genus is well represented in South Africa, Stal having described a number of forms from the region of the Cape.

Thamnotettix karrooensis sp. n. (Pl. VIII, Fig. 2).

General color brownish white. Length 3.5 mm. Breadth 1.25 mm.

Vertex white, with a dilute brown pattern, angularly rounded, the length equalling the width between the eyes, and about one-third of the distance across the eyes. Eyes large, dark brown, ocelli dark brown, surrounded by clear white spaces. Face dull brown, the frons two and a half times as long as the clypeus, and twice as long as its width between the antennæ; clypeus narrow, its sides almost parrallel, twice as long as its width next the frons; loræ about equalling the clypeus in width. Pronotum well rounded on its anterior margin, dirty brown in color, with an irregular pattern, one and a third times as long as the vertex; sternum yellow; black spots on the pro-, meso- and metapleura. Scutellum almost as long as the pronotum, with brown markings on the middle and at the basal angles. Elytra a dull white, the veins distinctly marked with fuscous, the outer margin of the corium white, except for the minute brown spots. Abdomen dorsally black, with yellow margins, ventrally dirty white, with black on the base and the middle. Genitalia: Female—Last ventral segment two and a half times as long as the preceding, the posterior margin inwardly rounded and slightly produced on the middle; pygofer one and a half times as long as the width at base, and three times as long as the last ventral segment; ovipositor a little longer than the pygofers. Male: Valve brown, with a yellow border, last ventral segment equalling the penultimate in length, but not quite as long as the valve; plates long and narrow.

Described from numerous examples of males and females from Beaufort West, C. P. (Mally).

Thamnotettix karrooensis var. pallidus.

Form and shape the same as T. karroensis. General color light yellowish to whitish, with the brown coloration generally absent. Face light yellow, the frons marked with dilute brown arcs. Ocelli san-

guineous. Genitalia female: last ventral segment almost two and a half times as long as the penultimate, white with brownish markings on the anterior half. Male: last ventral segment a little longer than the preceding. Males distinctly brown on the middle of the ventral part of the abdomen, the lateral margins yellow.

This variety was described from nine females and three males which were separated from T. karrooensis, on account of the absence of brown color pattern, and the general predominance of yellow.

Habitat: Beaufort West, C. P. (Mally).

Thamnotettix cotula sp. n. (Pl. VIII, Fig. 3).

General color yellowish brown. Length 3.5 mm. Breadth 1.25 mm.

Female: Head with the eyes prominent, vertex almost as long as the pronotum, fuscous yellow in color and characteristically marked with ten brown to black spots—two situated on the middle, one on either side of the median line, two somewhat smaller alongside these, but nearer the eyes, two large angular spots near the anterior margin, located close to one another and to the median line, two smaller spots on the anterior margin in advance of these; the other two spots are on the anterior half close to the lateral margin. The arrangement of these spots gives the insect a very characteristic appearance. Vertex acutely angled. Face strong, the frons fuscous with light arcs; clypeus almost twice as long as its width, less than half as long as the frons. Eyes large, dark steel gray; ocelli colorless located very close to the eyes. Pronotum fuscous yellow, equalling or a little longer than the vertex. Scutellum shorter than the pronotum, of the same yellow brown color. Elytra yellowish, transparent, the claval area irregularly marked with fuscous; apical cells fuscous at their borders. Abdomen above black, with yellow borders, beneath yellow. Legs light yellowish with alternate bands of fuscous on the coxæ and femora. Genital apparatus: ultimate ventral segment somewhat narrow, a little longer than the previous one, posterior margin notched at the middle, and rounding slightly to the sides; pygofers dark colored, twice as long as their width at base; spines strong and stout forming a rough crown at the tip of the ovipositor; the latter is longer than the pygofer, and is black at the sides and tip.

Male: General color the same as for the female; vertex shorter; the fuscous markings on the apical cells absent or not as prominent. Abdomen beneath dark brown. Genitalia: last ventral segment yellow on the middle, black at the sides, equalling the penultimate in length; valve semi-circular, small, not well exposed; plates angular at the tips, one and a half times as long as the last ventral segment; pygofers longer than the plates, rounded laterally; spines large.

Described from one male and one female.

Habitat: Cape Town (Mally).

Thamnotettix pentzia sp. n. (Pl. IX, Fig. 1).

General color brownish, somewhat smoky. Length of female 4.5 mm; male 4 mm. Breadth 1.35 mm.

Vertex about half the length of the pronotum; disk flat and sloping, width between the eyes greater than the length on the middle, color whitish marked irregularly with fuscous. Eyes large, dull reddish, extending back almost to the middle of the lateral margin of the pronotum; ocelli red, located near the eyes. Color of face, a dirty white with indistinct brown arcs on the frons, the loræ brownish next the clypeus; width of frons at the eyes shorter than the length; clypeus a third of the length of the frons, rectangular in shape, its length being twice that of its breadth; loræ as wide as the clypeus. Antennæ long, inserted deeply, the point of insertion being brownish. Pronotum twice as wide as its length, color bluish white with many transverse markings of a brown color and a distinct pattern; lateral margins yellowish, below black. Scutellum not quite as long as the pronotum, wider than long; with two prominently brown spots alongside the middle, and two yellowish markings at the basal angles, otherwise dirty white. Elytra white with the brownish pattern, very long, the appendix narrow, the margins transparent and without brown markings on the corium as far as the apical cells. Abdomen above black, whitish on the lateral margins, and black beneath. Genitalia female: last ventral segment almost three times as long as the penultimate, and about one and a half times as wide as its length, roundedly produced and notched on the middle; penultimate segment slightly curved inward on the middle of its posterior margin; pygofers two and a half times as long as the last ventral segment, and one and two-thirds longer than the width at base; ovipositor broad, light colored, except at the tip which is black, longer than the pygofer. Male: Whitish in color, the last ventral segment a little longer than the penultimate, valve small about one-third as long as the last ventral segment; plates sharp and long, about two and a half times the length of the ultimate ventral segment.

The males of this species are much lighter in color ventrally than the females.

Described from two females and one male.

Thamnotettix struthiola sp. n. (Pl. IX, Fig. 2).

General color bluish white with a brownish black pattern. Length 3.75 mm. Breadth 1.25 mm.

Vertex white with delicate though distinct black markings; a short median line extending from the posterior margin to the middle; width between the eyes about equal to twice the length of the vertex, which is flat on the disk, angularly rounded at the apex, and has its sides sloping; width across the eyes almost three times the length of the vertex. Eyes large, well rounded, dark gray in color; ocelli dilute red, located near the extremities of the frontal sutures. Face white interspersed with brown and black markings, which are somewhat variable in the different

individuals; frons with two brown markings near the margin of the vertex and from four to six brownish arcs on the middle, length five times as much as the width next the clypeus and two and a half times as long as the latter, which is strong, well rounded at the tip, where it is a little wider than at the base; clypeus about twice as long as its width; loræ not quite as wide as the clypeus, genæ white, broad. Brown spots on the face between the frontal sutures and the eyes, just beneath the insertion of the antennæ. Pronotum irregularly marked transversely with wavy brown; almost twice as long as the vertex, flat on the middle but slightly convex at the sides; lateral margins short; width of pronotum equal to twice its length; sternum jet black. Scutellum dirty brown with two blackish markings at the basal angles, a rectangular brown marking on the middle and extending to the apex; indistinct brown spots on the middle and anterior half; length about equaling that of the pronotum. Elytra whitish blue, with a distinct brown pattern; claval area rather long, leaving a small apical area; outer borders white or with few brown marks. Genitalia male: Last ventral segment brownish, a little longer than the penultimate; valve almost as long as the ultimate segment, plates long, slender and sharp, much longer than the pygofers and about three times as long as the last ventral segment; tips very pointed. Female: Last ventral segment whitish, about four times as long as the preceding; posterior margin inwardly and angularly rounded, then produced on the middle, the production being pronounced; slightly convex on the top; pygofers brownish, strong, almost three times as long as the last ventral segment and more than twice as long as their width at base; rather widely separated; ovipositor long and broad, longer than the pygofers, sharp at the tip.

Described from three females and four males.

Habitat: Beaufort West, C. P. (Mally).

Tribe Cicadulini.

Genus **Cicadula** Zett.

Body elongate or oblong, usually much narrowed behind. Head obtuse in front; frons almost straight sided. Pronotum usually longer than the vertex. Elytra longer than the abdomen, overlapping at the apex; appendix present; inner sector not forked.

Cicadula 6-notata Fall.

Cicadula sexnotata Fallen. Acta Holm. XXII. 34. (1806).
Edwards. Hem. Homop. Brit. Is. 187. (1896).
Melichar, Cicad. v. Mittel-Europa. 309. (1896).
Osborn. Bull. U. S. Dept. Agr. No. 108. 97. (1912).

General color light yellowish green. Length 3.5 to 4 mm.

Vertex marked characteristically with six black spots arranged in pairs, two on the anterior margin near the middle, two larger posterior to these, and two smaller spots on the hind part of the vertex. Frons prominently marked with black lines. Body black above, yellow below; abdomen black with the lateral ventral borders yellow. Genitalia:

Last ventral segment of female yellow, a little longer than the penultimate; pygofer yellow, ovipositor black, equalling the pygofer in length. Male: Color whitish, valve short, somewhat angular; pygofer longer than the plates, which are triangular.

This insect is here recorded from South Africa for the first time. It is widely distributed over Europe and North America, having attracted considerable attention on those two continents because of its economic importance. Osborn places it among the six most important leafhoppers affecting cereal and forage crops in the United States. Its occurrence in South Africa is interesting, in view of the attention which it has attracted in other countries.

Habitat: Cape Town (Mally).

Cicadula longiforma sp. n. (Pl. XI, Fig. 3).

Form long and slender, resembling a Gnathodus to some extent. General color light yellow. Length of female 4.25 to 4.5 mm.; male 4 mm. Breadth 1 mm.

Vertex yellow, narrow, rounded anteriorly; two light brownish arcs on the anterior margin, a small longitudinal line on the middle, extending from the posterior margin; length about one-third of the width between the eyes. Face generally yellowish brown, with the cheeks lighter in color; frons twice as long as its width, and three times the length of the clypeus, with six arcs traversing its surface; cheeks rather broad, equalling the frons in width; clypeus about one and a half times as long as its width and about as wide as the lora. Eyes large and prominent, black below and grayish above; ocelli dilute brown, located close to the eyes. Thorax well developed, the pronotum three times as long as the vertex; slightly convex on the middle; color light yellow with many irregular and indistinct brown markings on the anterior half; anterior margin well rounded between the eyes, the posterior straight. Scutellum yellowish, with a few irregular faint brown spots, basal angles of a deeper hue than the apex, more than half as long as the pronotum, with a distinct transverse line on the middle. Elytra long, much longer than the abdomen, faint yellow, transparent; length exceeding the abdomen by the distance from the apex of the claval suture to the apex of the membrane. Abdomen above brownish, yellow at the lateral margins; beneath yellow, interspersed with black. Legs light yellow with the tarsi brown. Genitalia: Female—last ventral segment longer than the penultimate, emarginate, convex; pygofers long and narrow, widely separated at the base, about twice as long as the last ventral segment and about one and a half times as long as the width at base; ovipositor equalling the pygofers in length, rounded at the tip. Male: Last ventral segment large, longer than the preceding; valve thick, shorter than the last ventral segment; plates long and narrow at the tips; pygofers longer than the plates.

Described from two males and two females.

Habitat: Cape Town, C. P. (Mally).

FAMILY TYPHLOCYBIDÆ.

The members of this family may be easily recognized by the four longitudinal veins or sectors of the elytra, which fork at the base and run to the cross-nervures, forming the apical cells. There are no anteapical cells in the elytra, nor is there a supernumerary cell present in the hind wings.

Genus **Empoasca** Walsh.

Generally small species, with the sectors of the posterior wings ending in a marginal vein, and with one apical cell in the hind wing. No appendix present on the elytron.

Empoasca protea sp. n. (Pl. X, Fig. 1).

Color greenish yellow, with the green predominating. Length 2 mm. Breadth .5 mm.

Face light yellow, fainter next the clypeus; genæ, loræ and clypeus light green. Entire length of face exceeding the breadth by about one-half of the former. Head somewhat large, slightly wider than the pronotum; vertex greenish, with irregular dark markings, and a faint white line extending along the middle from the posterior to the anterior margin; slightly elevated, giving a convex appearance. Anterior of head angularly rounded, the angle less than a right angle. Eyes dark green to black, large; width between eyes a little more than the length of the vertex. Pronotum brownish green, with a faint white line on the middle, running longitudinally from the posterior margin almost to the anterior edge; two rather indistinct spots on either side of this line, located on the anterior half; length of pronotum a little greater than the vertex; anterior margin almost straight between the eyes, lateral margins rounded, slightly convex above; twice as wide as its length. Scutellum greenish brown, about equalling the pronotum in length; a small transverse furrow near the apex. Elytra light green, translucent; venation distinct. Hind wings with the marginal vein somewhat produced. Abdomen yellowish, below greenish. Legs green, yellow at coxæ. Female genitalia: distinct green, last ventral segment twice as long as the penultimate, sinuate and roundedly produced on middle. Pygofers strong, twice as long as the width at base, ovipositor a little longer.

Described from three females.

Habitat: Table Mountain, Cape Town (Mally).

Empoasca heliophila sp. n. (Pl. X, Fig. 2).

Color yellowish, more or less tinged with green. Form long and slender. Length 3 mm. Breadth scarcely 1 mm.

Face distinctly yellow, shading into greenish below, long and slender, with the clypeus about one-third of the length of the frons. Cheeks and loræ greenish yellow; eyes pale green. Ocelli present, located on the anterior margin of the head, brown in color. Vertex yellow, slightly produced in front, its length less than the breadth between the eyes, and

equal to about half the length of the pronotum and about one-third of the total width of the head across the eyes. Pronotum yellow, lighter than the head on its posterior half; not quite as long as the width between eyes. Scutellum light brown to yellow, not quite as long as the pronotum. Elytra pale greenish yellow. Abdomen dorsally yellowish green, venter greenish. Legs light yellowish green. Female genitalia: Last ventral segment more than twice as long as the penultimate, produced on middle, rounding to the sides; pygofers twice as long as their width at base. Ovipositor longer than the pygofers.

Described from three females.

Habitat: Cape Town (Mally).

Genus **Typhlocyba** Germ.

Sectors of the posterior wings ending in the wing margin, no marginal vein. Only three veins running to the margin.

Typhlocyba purpureatincta sp. n. (Pl. X, Fig. 3).

Color dark brown above, tinged with purple, beneath yellowish. Length almost 3.25 mm. Breadth 1 mm.

Face brownish yellow, the clypeus darker, almost black, with the cheeks and loræ light yellow. Eyes black above, yellow below. Vertex faint yellow, with two irregular dark spots near the middle, moderately produced, the apex considerably rounded; anterior margin angularly rounded, the angle less than a right angle; length of vertex about equal to half the width between the eyes. Pronotum brown above, yellow beneath, anterior margin well rounded between the eyes; posterior half wider than the head; almost twice as broad as its length and about twice as long as the vertex; posterior margin slightly concave; two furrows running from the middle behind the eyes, to a little beyond the posterior half. Scutellum brownish at angles next the pronotum, with a rectangular purplish marking on the middle; indistinctly striate; a little longer than the pronotum. Elytra light brown, with a distinct purple tinge, translucent, the veins showing as darker brown lines; a pronounced longitudinal purple marking on the outer margin of the middle of the corium; entire margin of elytron of a darker hue than the remainder; two apical cells apparent in posterior wing. Abdomen yellowish brown dorsally, dirty yellow ventrally. Legs a dirty yellow, hind tibiae hinged with purple. Female genitalia: dark purple, the last ventral segment brownish, a little longer than the penultimate; ovipositor narrow, a little longer than the pygofers.

Described from two females.

Habitat: Table Mountain, Cape Town (Mally).

Typhlocyba mallyi sp. n. (Pl. XI, Fig. 1).

General color yellowish brown, with the elytra dull greenish. Form short and stout. Length not quite 3 mm. Breadth a little more than 1 mm.

Vertex yellowish brown, unicolorous with the face, not produced at all; considerably rounded anteriorly, and slightly elevated at the middle;

about half as long as the pronotum; a small black line extending from the posterior margin to the middle; width between the eyes about three times the length of vertex. Face yellowish brown with the frontal sutures almost black; frons narrow, three times as long as its width; clypeus dark brown, about one-fourth of the length of the frons; loræ small, light yellow; cheeks somewhat fainter in color. Ocelli present, colorless, located at the extremities of the frontal sutures. Pronotum yellow on anterior half, brown on posterior. More than twice as broad as long, the length being less than the width between the eyes; side margins rounded, posterior margin slightly concave on middle; somewhat rugose, and concave on top. Scutellum yellow, with two brown spots at the base, and an indistinct spot near the apex; slightly longer than the pronotum. Elytra greenish brown with traces of yellow on the claval area; transparent; margin of the clavus light brown, the corium greenish, with a longitudinal brown marking on the middle, extending from the margin to the second sector. Abdomen above black, brownish at the tip, and yellowish brown beneath. Female genitalia: Last ventral segment strongly produced to a blunt point, brown on middle with yellow borders, twice as long as the penultimate segment; pygofers stout, a little longer than their width at base; ovipositor a little longer than the pygofers. Legs light yellow, becoming brown at the tarsi.

Described from one female.

Habitat: Cape Town (Mally).

Typhlocyba elegia sp. n. (Pl. XI, Fig. 2).

Form long, sharp; color light yellow, the vertex and pronotum marked with brown. Length 4 mm. Breadth 1.5 mm.

Face pale yellow, greatly elongated, almost twice as long as its breadth; frons narrow, the sutures almost parallel, about four times as long as the clypeus, which is short, and a little longer than wide. Cheeks and loræ white, the latter long and narrow; clypeus black. Eyes black with a whitish band on the middle. Vertex yellow, somewhat produced, the anterior end rounded, not as long as the pronotum, and shorter than the width between the eyes; a large brown irregular spot on the middle of the disc. Pronotum pale yellow, with a large brown marking on the middle, extending from anterior to posterior margin and widening considerably on the middle; indistinct brown marks on the lateral margins. Scutellum yellow with two black spots at the basal angles, and a large black spot at the apex; brownish markings on the middle; not as long as the pronotum. Elytra yellow, transparent, with brown markings on the claval area, also on the corium, parallel to the claval suture; much longer than the abdomen; middle apical cell narrow, the sides subparallel. Abdomen above brown, white on the borders and bright yellow beneath. Female genitalia: Last ventral segment twice as long as the penultimate, strongly produced, the production being V-shaped; pygofers strongly rounded to the sides, ovipositor strong, a little longer than the pygofers, black at the tips. Legs light yellow.

Described from three females.

Habitat: Cape Town, C. P. (Mally).

Date of Publication, March 17, 1916.

EXPLANATION OF PLATES.

Plate IV.

Figure 1. Macropsis subolivaceus Stal. a, adult; b, face; c, male genitalia; d, female genitalia; e, elytron.
Figure 2. Pediopsis capensis. a, adult; b, face; c, male genitalia; d, elytron.
Figure 3. Idiocerus hewitti. a, adult; b, elytron; c, female genitalia.

Plate V.

Figure 1. Agallia nigrasterna. 1, adult; 2, face; 3, elytron; 4, male genitalia; 5, male genitalia, side view.
Figure 2. Agallia cuneata. 1, adult; 2, face; 3, female genitalia; 4, elytron.

Plate VI.

Figure 1. Cephalelus infumatus Perch. 1, adult female; 2, adult male; 3, nymph; 4, face; 5, female genitalia; 6, male genitalia; 7, dorsal view of posterior end of female abdomen.
Figure 2. Deltocephalus breviatus. 1, adult; 2, face; 3, female genitalia; 4, male genitalia; 5, elytron.
Figure 3. Deltocephalus aristida. a, adult; b, face; c, female genitalia; d, elytron.

Plate VII.

Figure 1. Athysanus capicola Stal. a, adult; b, female genitalia; c, male genitalia; d, face; e, elytron.
Figure 2. Athysanus aethiopica. a, adult; b, female genitalia; c, face; d, male genitalia; e, elytron.
Figure 3. Athysanus eriocephalus. a, adult; b, female genitalia; c, male genitalia; d, face; e, elytron.
Figure 4. Athysanus cyclopia. a, adult; b, female genitalia; c, face; d, elytron.

Plate VIII.

Figure 1. Athysanus nemesia. 1, adult; 2, face; 3, male genitalia; 4, elytron.
Figure 2. Thamnotettix karooensis. a, adult; b, female genitalia; c, male genitalia; d, face; e, elytron.
Figure 3. Thamnotettix. cotula. a, adult; b, female genitalia; c, male genitalia; d, face; e, elytron.

Plate IX.

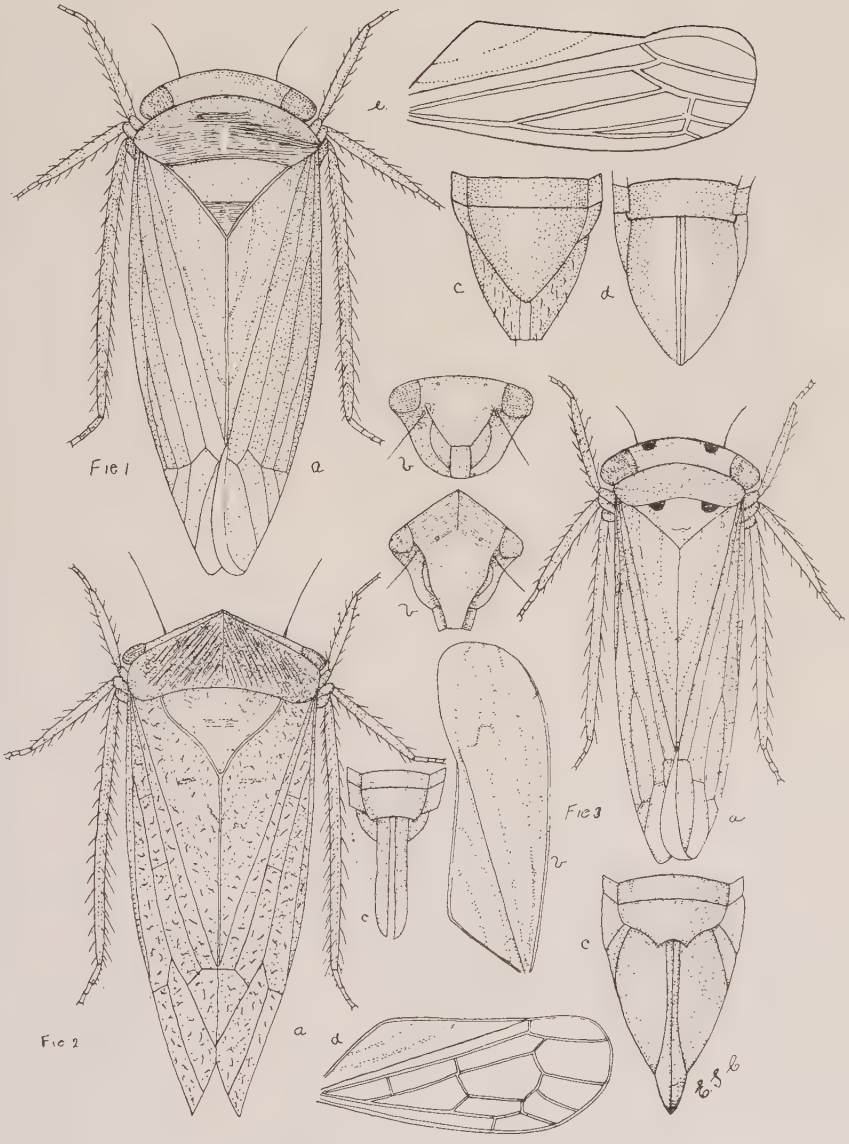
Figure 1. Thamnotettix pentzia. 1, adult; 2, face; 3, male genitalia; 4, female genitalia; 5, elytron.
Figure 2. Thamnotettix struthiola. 1, adult; 2, face; 3, female genitalia; 4, male genitalia; 5, elytron.

Plate X.

Figure 1. Empoasca protea. a, adult; b, female genitalia; c, face; d, elytron; e, hind wing.
Figure 2. Empoasca heliophila. a, adult; b, face; c, female genitalia; d, elytron; e, hind wing.
Figure 3. Typhlocyba purpureatincta. a, adult; b, face; c, elytron; d, hind wing.

Plate XI.

Figure 1. Typhlocyba mallyi. a, adult; b, female genitalia; c, face; d, elytron; e, hind wing.
Figure 2. Typhlocyba elegia. a, adult; b, face; c, female genitalia; d, elytron; e, hind wing.
Figure 3. Cicadula longiforma. a, adult; b, face; c, female genitalia; d, male genitalia; e, elytron.



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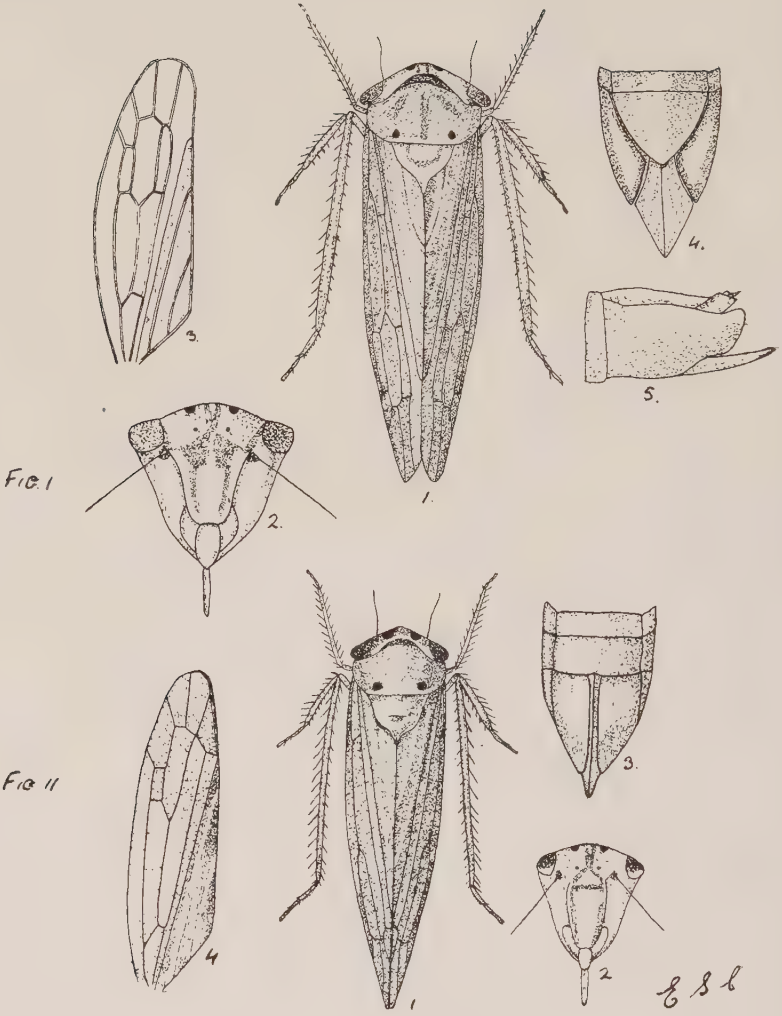

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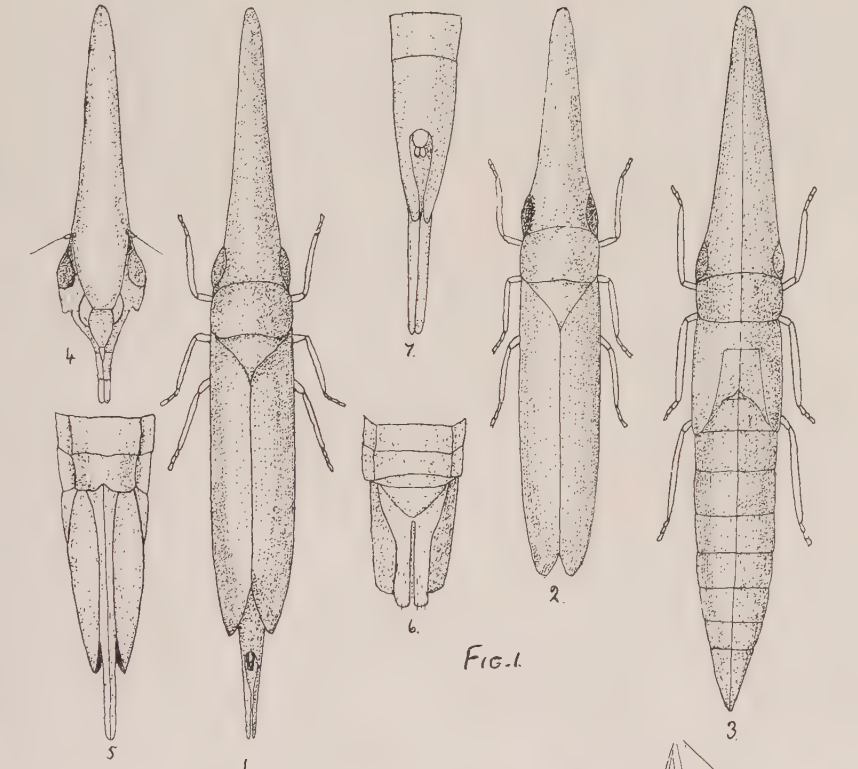
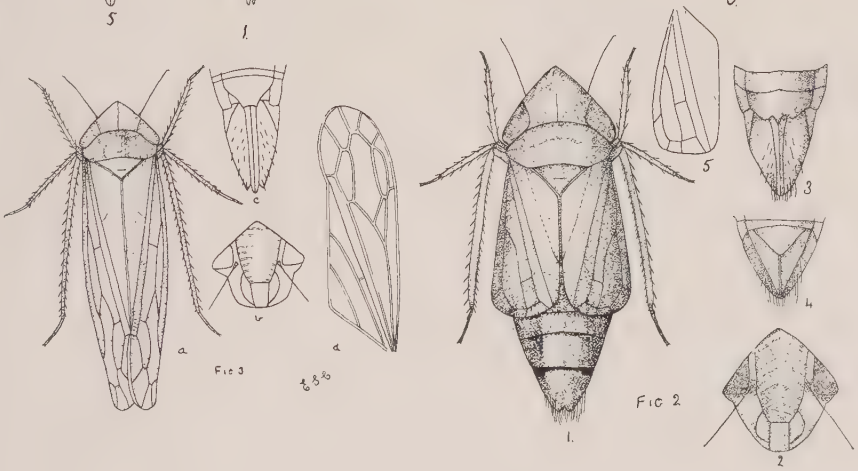


Fig. 1.



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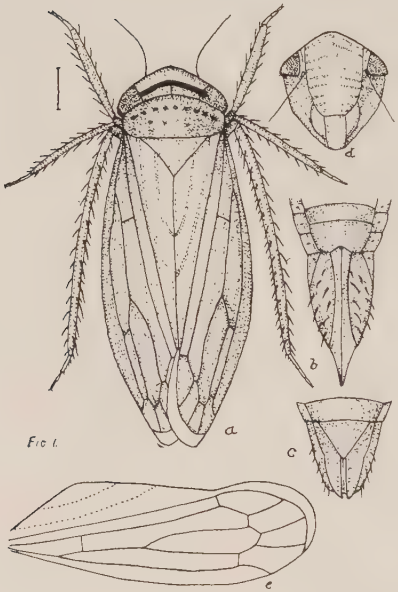

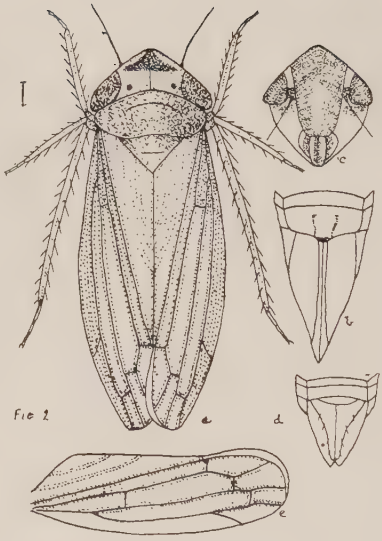

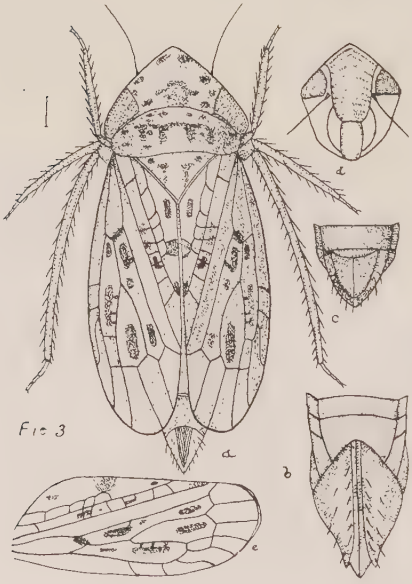

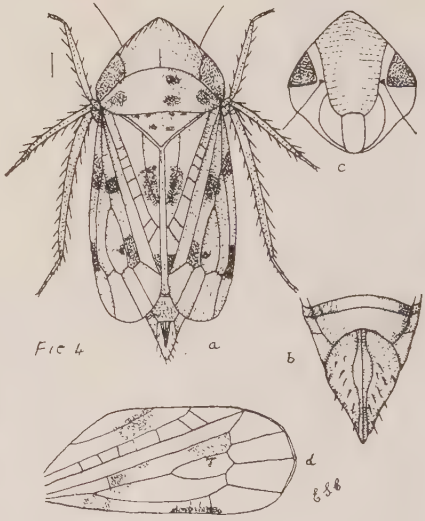

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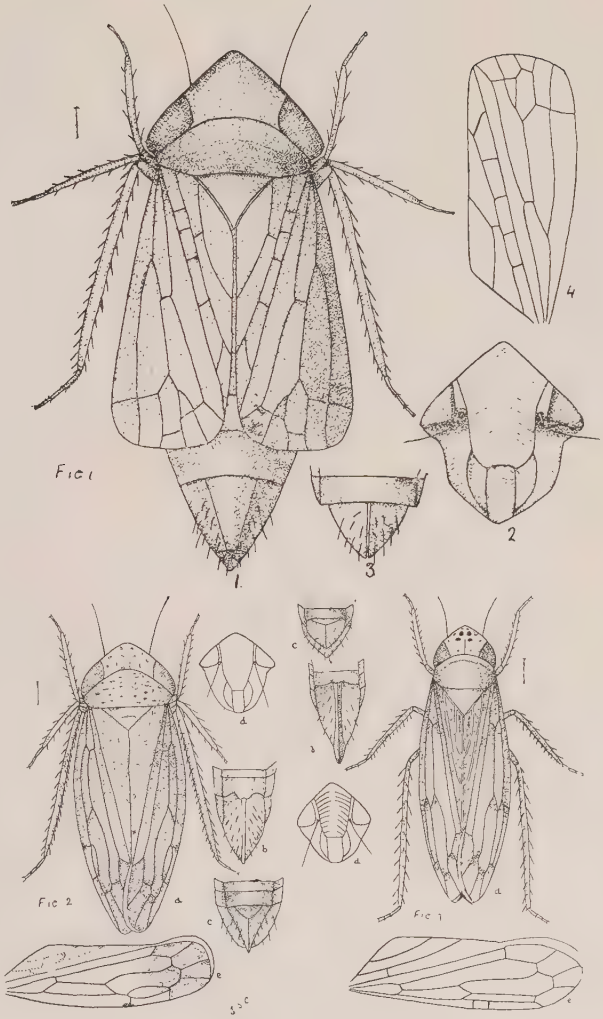

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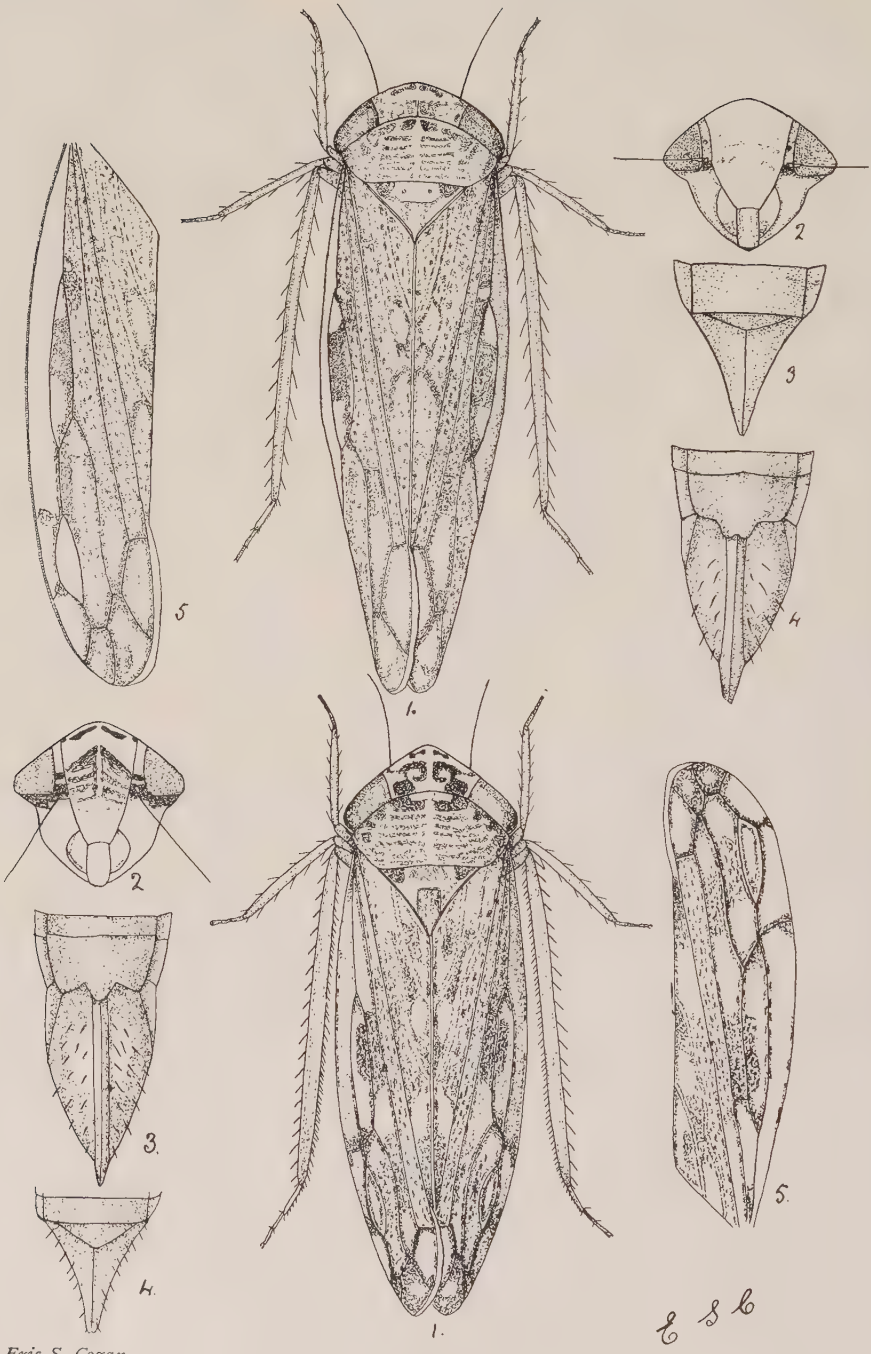

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Fig. 2

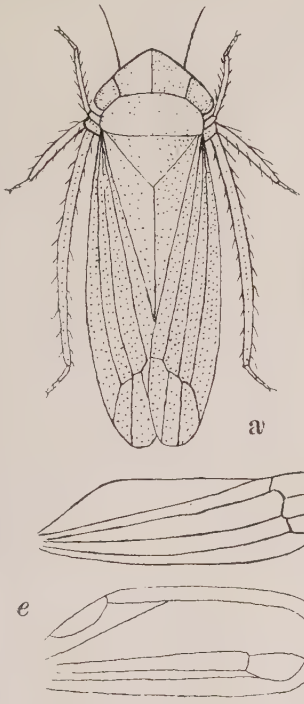

Fig. 1

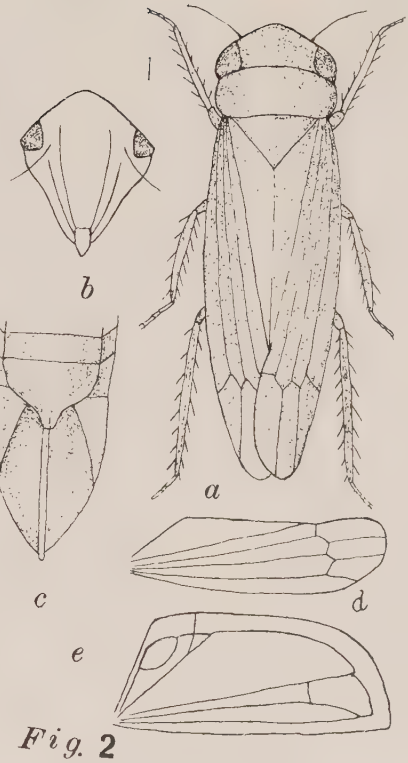

Fig. 2

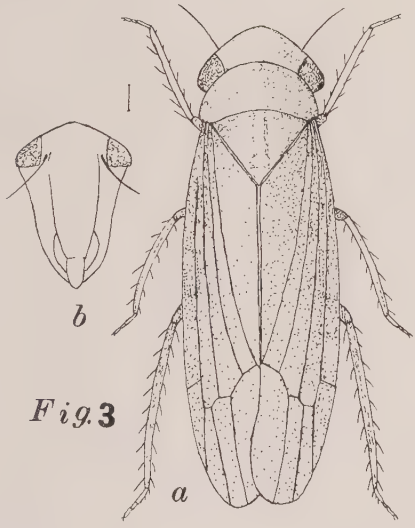

Fig. 3

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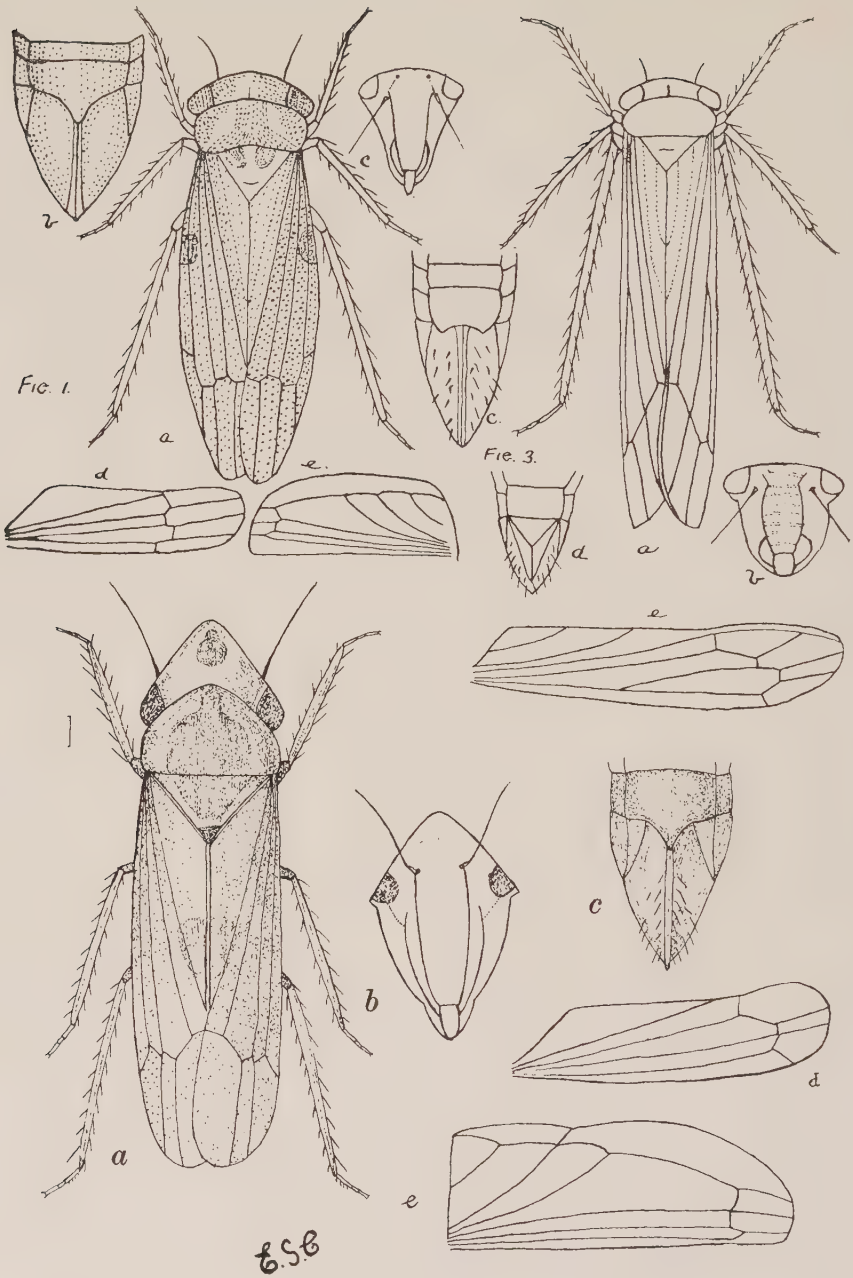

Fig. 2

Eric S. Cogan

HOMOPTEROUS STUDIES. PART II.

Morphological Studies of the Superfamily Jassoidea.

Eric. S. Cogan, M. A.

Introduction.

The Superfamily Jassoidea comprises a large number of small or comparatively small Homopterous insects, which agree in respect to the character of the hind tibiæ. The latter are prismatic in shape and are armed with a row of spines on their posterior margins. The head varies in shape and may be angular or rounded, produced or shortened. The eyes are located on the lateral margins of the head, and the breadth across them is frequently the widest part of the body. The antennæ are usually inserted on the face between the eyes. The thorax varies considerably, but in all the pronotum is the most pronounced region. There are two pairs of wings, the first pair being developed as tegmina and are usually coriaceous, while the second pair may be membranous. In some forms the elytra are reduced in size.

The superfamily is generally subdivided into four subfamilies, viz.: Bythoscopidæ, Tettigoniellidæ, Jassidæ and Typhlocybidæ, the subdivision of the first three being based on the location of the ocelli, and of the last, on the character of the venation of the elytra. In the Bythoscopidæ, the ocelli are situated on the front below the border of the vertex; in the Tettigoniellidæ they are on the disk of the vertex, while in the Jassidæ they are to be found on the border of the vertex or between the latter and the face. In the three subfamilies mentioned, the elytral nervures fork on the disk, while in the Typhlocybidæ the nervures fork at the base and run to the apex of the elytron without further dividing. Again in the last named family the ocelli may or may not be present. The various subfamilies are further subdivided into a number of genera, and frequently into tribes and divisions.

The chief object of this investigation has been to obtain a definite understanding of the external and internal anatomy for the group generally and to establish homologies with the

other Homopterous families. Very little work has been done on the anatomy of the Jassids, and as far as the writer is aware, no complete treatment of any phase of the morphology has yet been offered. Considerable work has been accomplished on the other Auchenorrhynchous families by Muir, Kershaw, Licent, Pantel, Bugnion, Sulc and others, but the only treatment of the Jassoid anatomy is to be found in the general discussions of systematic works on the group. Thus the works of Signoret, Burmeister, Flor, and Melichar contain general discussions of the external anatomy, which are necessary for taxonomic purposes. The wings and their structure have been ably treated by Metcalf, and only mention will here be made of this phase.

Since the only work on the external anatomy of the Jassoidea has been done by systematists and for taxonomic purposes, Professor Osborn suggested to the writer that an investigation into the morphology of the group would be of some avail, and accordingly the work was undertaken. The scope of the investigation is confined to the four families. A common and seemingly generalized species was selected from each family and in the main the studies here noted were conducted on these. For the Bythoscopidæ, Agallia sanguinolenta was selected chiefly because the material, both adult and nymph, was abundant and readily obtainable; the same may be said of Draeculacephala mollipes for the Tettigoniellidæ, Deltocephalus inimicus for the Jassidæ, and Empoasca mali for the Typhlocybidæ. In many cases species belonging to other genera were studied and compared with the above where such was necessary. To Professor Osborn the writer wishes to express his indebtedness for directing the investigation, and for helpful criticism and suggestion.

Methods.

The material for gross dissection was killed and preserved in a 4 per cent. solution of Formalin and found to be quite satisfactory. Some specimens were killed in hot water and preserved in 70 per cent. alcohol. In many cases material which had recently been collected in the field was killed in 100 per cent. alcohol and dissected and examined immediately. All dissection was accomplished by means of a Bausch and Lomb binocular microscope. For the dissection of the smaller

insects, a shallow dissecting pan made by filling a watch glass with paraffin, proved very convenient. The study of many of the chitinized parts was facilitated by previously boiling the specimens in a 10 per cent. solution of potassium hydroxide, washing in water and examining in glycerine or alcohol. The former proved very suitable, and has the advantage in that it evaporates very slowly. In the dissection of the reproductive organs and the digestive apparatus, normal salt solution was used to float out the organs. Some of the immature forms were conveniently studied by simply killing in Xylol and mounting in balsam almost immediately. Certain structures, such as the tracheal system, show up clearly when treated by this method.

Material for sectioning was killed mainly by two methods. Hot water was used where the insect has recently moulted and the chitin had not yet hardened. Carnoy A (Glacial acetic acid one part, to absolute alcohol three parts) proved to be a very good fixing fluid. Practically all the material for sectioning was killed by this method. Delafields haematoxylin and eosin were the stains used for staining sectioned material. Staining in toto did not prove satisfactory. Picric acid for staining chitin was used to some extent. The material was embedded and cut in paraffin with a melting point of 55 C.

THE HEAD.

External Anatomy. (Pl. XXI, XXII, Figs. 1, 2, 3, 4, 5, 7, 25–31).

The different regions of the Jassoid head have been well defined by systematists in the group and before proceeding to a discussion of the structure, it will be as well to outline these regions, which now, for the most part, are of interest because of their place in the taxonomy of the superfamily. The dorsal region, i. e., the portion of the head between the compound eyes is termed the vertex (v), and in some of the families it bears the paired ocelli (o). Although not a definite sclerite, it serves as a good "landmark" for descriptive purposes. The region from the anterior edge of the vertex to the first apparent transverse "suture" is regarded as the front ("frons"); its lateral margins are limited by the longitudinal sutures which run from the antero-lateral edges almost to the antennæ and frequently to the anterior edge of the head. Attached to the

anterior edge of the frons is the broadly rectangular clypeus, and at the distal edge of the latter is seen the small peglike labrum. At the sides of the frons and clypeus, two small semi-circular plates are seen, these are the loræ. The genæ are the large regions extending from beneath the eyes to the anterior edge of the clypeus and completely surrounding the loræ. The rostrum or beak projects from under the surface of the clypeus and encloses the setæ. The head is greatly deflexed with the result that the rostrum lies between the anterior coxæ and projects in a caudal direction.

The same regions as are seen in the Jassoid head are to be differentiated in the Cicada, or any other of the Auchenorrhynchous Homoptera. In 1896 Marlatt drew attention to the fact that the frons of Cicada septendecim was really the clypeus, that the clypeus and labrum constituted the labrum, and that the loræ were the external representatives of the mandibles, while the genæ were the corresponding pieces of the maxillæ. No attempt was made to homologise the various parts, until the work of Muir and Kershaw appeared in 1911. From a study of the external and internal anatomy as well as the development and embryology of both Homopterous and Heteropterous forms, these authors concluded that the "frons of many writers was the clypeus, and their clypeus was the labrum. The loræ have no connection with the mandibles, but are lateral developments of the clypeal region. The dorsal and outer pair of setæ are the mandibles, developed direct from the first pair of appendages behind the stomodaeum of the embryo, and articulated in their normal position, viz., on the oral margin between the clypeus and the maxillæ. The ventral and inner pair of the setæ are part of the maxillæ developed directly from the distal joint of the second pair of appendages behind the stomodaeum of the embryo, the basal joint being directly developed into the maxillary plate." In a paper on the Development of the Mouthparts in Homoptera, the same authors conclude that "(1) The mandibles and maxilla arise as in other insects, the former being articulated in an approximately normal position. (2) The Homopteran and Heteropteran mouthparts arise and develop in the same manner. (3) There is no mandibular plate. (4) The tentorium agrees essentially with that of other insects. (5) The maxillary seta does not represent the palpus, but may be a development

of the palpifer or the combined lacinia and galea. (6) The maxillary-plate represents the cardo and stipes." In their discussion of the Homology of the Hemipterous mouthparts, no reference is made to the Jassoidea, except that the Tettigoniellids can be easily homologised with the Cicada. Beyond this reference to the Jassoid head the writer has been unable to find further treatment of the subject.

In the following discussion of the Jassoid head, the fixed parts will be considered first and then the free or movable parts.

Fixed Parts of the Head. (Pl. XX, Figs. 1, 2, 3, 4, 5).

The Jassoidea agree with the other Hemipterous families in the general arrangement of the head and mouthparts. The head is greatly deflexed and the mouthparts are attached to the caudo-ventral portion of the capsule, with the result that the beak or so-called proboscis is directed caudally between the first pair of thoracic legs.

Head-Capsule.—As in a generalised insect, the head of the Jassid is composed of a number of sclerites, which have become united to form the head-capsule, and this becomes the external skeleton of the head. To this capsule, the various appendages of the head are attached and articulated. In the head it will be found that no trace of the primitive sclerites forming the head-capsule is to be found, for they have either disappeared or amalgamated with other sclerites. The various regions on the Jassoid head were indicated before, and only those areas which can be definitely recognized as sclerites will be considered here.

The dorsal region (v) of the head (i. e., the vertex) is not separable from the front or frons (Fr), and there is no trace of a suture between them, as one would expect. Together with the genæ and occiput, the vertex and front constitute the epicranium.

The vertex (v) varies considerably in size from a mere narrow region in the Bythoscopidæ to a greatly elongated area in the Tettigoniellids (especially in the Tribe Dorydini). It usually bears the paired ocelli (o); thus in the Family Tettigoniellidæ they are located on the disk or surface, in the Jassidæ on the cephalo-lateral margin near the eyes, and in the Typhlocybidæ (when present) also on the cephalo-lateral margin. But in

the case of the Bythoscopidæ they have been carried over and down on the face, while the dorsal surface of the vertex is greatly reduced.

The Front, although a true sclerite, is not readily differentiated from the following sclerite—the clypeus (clyp.)—the suture between them being obsolete, but its position can be judged by the fact that the anterior arms (i. a.) of the tentorium are invaginated on each side, where the suture should normally end. The front usually, at least in the more generalized insects, can be identified owing to the fact that it bears the median ocellus, but no trace of such an ocellus is to be found in the Jassid head. The frontal region ("frontal ridge") then would be the area between the cephalic margin of the head and a transverse line connecting the invaginations of the anterior arms of the tentorium. In the Jassoid head these invaginations occur at the cephalic end of the maxillary suture, on the so-called mandibular plates or loræ. Its lateral margins would be defined by the longitudinal sutures on either side of the head.

The clypeus (clyp.) is the sclerite attached to the frons along its anterior margin. In the Jassid head as in other Homoptera, it is not easily distinguished from the front; it is a broadly rectangular sclerite, generally somewhat convex with its lateral margins developed into two plates (loræ) which attach along the sides of the labrum. These two plates (the loræ or so-called mandibular plates) have long been regarded as the external pieces of the mandible, although in reality they have no connection with the mandibles. Muir and Kershaw have shown conclusively in their work on the development of the mouthparts of the Homoptera, that the mandibles become enclosed within the head in the course of development. No true suture exists where these two plates are in relation to the labrum, but their basal portion is attached strongly to the middle piece of the clypeus. If we consider the mesal piece as the clypeus proper, then the lateral developments might be regarded as the antecoxal pieces of the mandible.

The labrum (labr.) is the upper lip and is attached to the anterior margin of the clypeus. It constitutes the roof of the mouth and is differentiated with difficulty from the clypeus. However the anterior margin of the clypeus is connected with the pharynx by two small developments of the tentorium, and these

mark the region where labrum and clypeus meet. The shape of the labrum is broadly rectangular, with the anterior margin generally rounded off, and forming a covering for the basal joint of the labium. Projecting from under its anterior margin and fitting into the groove at the base of the labium is the small, peglike epipharynx (epi.). On an external view the epipharynx appears as part of the labrum, but on close examination it will be seen to run back as the dorsal wall of the pharynx.

The Occiput or the posterior part of the dorsal surface of the head can not be differentiated from the vertex. However, by viewing the head in its caudal aspect it may be seen as the large sclerite surrounding the occipital forearm. Attached to the ventral surface of the occiput, is the gula or gular region, which is very small in the Jassoid head, owing to the deflection. The gula consists of a small membrane attached at one end to the base of the occiput and at the other to the basal joint of the labium.

The Genæ proper cannot be distinguished from the maxillary plates—an amalgamation of the two sclerites taking place early in the development of the insect's head. No trace of a suture is to be found and we can only refer to the genæ in general terms as that region surrounding the compound eyes on either side of the face and attached to the maxillary plates, for the greater part.

Ocelli.—The ocelli (o) where present are two in number. As stated before, in the Tettigoniellidæ (Fig. 5), they are located on the mid-dorsal surface of the vertex, while in the Bythoscopidæ they are situated on the face (Fig. 3). The position in the case of the last named family is probably owing to development of the epicranium, which occupies the greater part of the dorsal region of the face. However, in the Jassidæ and Typhlocybidæ (where present), the ocelli are located on the cephalo-lateral margins of the head. On examining the internal structure of the head, it will be found that branches of the dorsal arms of the tentorium proceed to the head just beneath the ocelli. This was found to be the case in practically all the forms examined. The ocelli are small, clear, circular or oval structures, which are generally raised above the general level of the head. Frequently they are colorless or glassy, but in some cases they are pigmented with red or black.

Compound Eyes—The compound eyes (E) occupy the greater part of the dorsal aspect of the head at the sides of the vertex. They are large oval or semicircular bodies, which extend back to the anterior margin of the pronotum. In the immature forms they are relatively larger than in the adult and are more rounded. The character of the facets is the same as that of a generalised insect, although the number of these facets is exceedingly great.

Movable Parts of the Head. (Pl. XX, XXI, Figs. 6,7,13,16,17).

Antennæ (Figs 18–21).—The antennæ (A) are for the most part setaceous in form; structurally there is very little difference between the morphology of the antennæ in the various forms, although it will seem as well to indicate here the more important of these. The number of segments or joints varies considerably and frequently cannot be distinguished at the distal ends. The basal segment and those adjoining it are the most modified in size. In the males of Idiocerus (Bythoscopidæ) the distal joints of the antennæ are developed into small oval plates, which Hansen has regarded as sensory structures. In many of the Tettigoniellids and Jassids, small hairs or spines are developed on the basal joints of the antennæ. The antenna of Deltocephalus inimicus figured shows this structure (Fig. 19). These spines may have some sensory function, although no trace of sense cones were found on them. The antennæ are inserted on the face between the compound eyes and the longitudinal suture of the front. In some cases the point of insertion may be a deep cavity, in others it may be shallow. In some of the Bythoscopidæ the cavity is overlapped by a distinct ledge.

Labium—(Pl. XX, Figs. 9, 13). The beak or proboscis of the Jassid mouthpart is the labium or lower lip. It is relatively short and thick, circular in outline, and is three-jointed. The distal joint, or tip of the labium is the largest, the proximal the smallest and the middle is about intermediate in size between the two. Externally the labium appears to emerge from under the labrum, but a closer examination will reveal the fact that the tip of the epipharynx, a small, peg-like structure, which is attached to the anterior end of the labrum, fits into a narrow groove on the surface of the labium and gives it some means of support in one direction. Ventrally the labium

is attached by its strong lateral and central muscles to the gula and to the body of the tentorium. The membrane of the proximal joint is developed into a central chitinous rod, to which attach the central muscles (c); at the sides the muscles attach directly to the basal joint at one end and to the gula at the other. The labium forms the floor of the mouth, and encloses the mandibular and maxillary setæ. As the mouth-parts of the Jassid are fitted for sucking, the two pairs of setæ are in close relation in the trough which runs the full length of the labium. This trough is shallow, and closed for the greater part beyond the epipharynx. The maxillary setæ form the sucking tube through which the plant juices are drawn. It is quite possible that the mandibles form the piercing organs, by means of which the maxillæ are enabled to function. Two sets of muscles are to be found in the labium—circular (c. m.) and longitudinal. The longitudinal muscles enable a back and forward movement, such as protrusion and withdrawal, while the circular muscles allow of an up and down movement. The attachment of the labium to the gula is not very strong and frequently on removing the head from the body, the labium will remain attached to the anterior edge of the prosternum. The setæ are capable of withdrawal from the trough of the labium, and may be free—this is often the case in nymphal forms. At the anterior edge of the labrum where the setæ emerge from the head capsule into the labium, a small membrane covers the entrance to the labium, making the structure airtight. This is necessary when it is considered that the plant juices constituting the food of the insect must be sucked up into the pharynx.

The tip of the labium is rounded and the setæ are protruded through a small hole at the end. The external region of the labium is chitinized, and is set with numerous hairs or spines. In feeding, the labium is applied to the plant leaf or tissue and forms a guide for the setæ. It however, does not enter the plant tissue. It is quite possible that the close application of the labium to the plant will render the connection airtight so that the juices may more readily be sucked up.

Maxillæ—(Pl. XX, Figs. 7, 17, 5, 4, 3). If the head of a Jassid be examined, two large plates (mx. pl.) forming the sides of the face and the lateral covering of the mouth, will be

found. These are the maxillary plates (mx. pl.), and they occur in all Homoptera. Although the maxilla are fused with the genæ, they can be distinguished from the latter in that they articulate with the maxillary setæ (mx. s.), which are enclosed within the head-capsule. The maxillary plates extend around the sides of the face and constitute the border; they completely surround the clypeus and meet anteriorly beneath the labrum, where they are connected by a membrane. At the sides the plates are turned down and under, forming the part of the ventral surface of the head. Distally they turn back on the under side of the head, and develop into two rectangular chitinous plates—with which the maxillary setæ articulate. The maxillary setæ are attached to these chitinous plates, which in turn are hinged to the body of the tentorium (t. b.).

The maxillary setæ (mx. s.) resemble the setæ of other Homoptera; they are long and slender for the most part, but their proximal basal region is swollen, and attaches to a small tendon (t.), which passes dorsally into the retractor muscles (mx. r.) of the setæ. A membrane sleeve surrounds the seta, as far as the entrance to the labium. The strong protractor muscles (mx. p.) of the maxillary setæ are attached to the maxillary plate, while the retractor muscles attach to the head-capsule at the sides of the occiput. The articulation of the seta is on the inner side of the maxillary plate and it can easily be seen by reference to the figure (Pl. I, Fig. 7) how the maxillæ can be worked forward and backward.

The exact homology of the maxilla in Homoptera is a question on which no little discussion has arisen. The amalgamation of the maxillary plate with the genæ, would lead one to believe at once that the whole of the plate at that side of the clypeus constitutes the gena, but on examining the internal structure, and the connection of the maxillary plate with the maxillary seta, it can readily be seen that the maxillary seta is intimately connected with the maxillary plate. Added to this the invaginations of the posterior arms of the tentorium are to be found at the sides of the occipital foramen, and are adjacent to the attachment of the maxillary plates with their setæ. In all the insects so far examined, the invaginations of the posterior arms of the tentorium have always been associated with the point of attachment of the maxilla.

Mandibles—(Pl. XX, Figs. 6, 16, 2, 4, 3). Viewing the head on the inside from its caudal aspect, the two pairs of setæ, viz., the mandibular (m. s.) and maxillary setæ, can be seen attached to the head capsule. These two pair of setæ are in rather close relationship, but with careful dissection it will be seen that the more dorsal pair are articulated with head-capsule, between the maxillary plate and the clypeus. The posterior end of the mandible is produced into a small tendon (t) to which attach the strong retractor muscles (m. r.) which attach in turn to the head-capsule at the sides of the occipital foramen. A small tendonous rod (m. a.) connects the mandibular seta with the latero-posterior edge of the clypeus. While the mandibular seta is intimately related to the maxillary seta in the labium, the two are separate within the head-capsule. The mandibles are capable of being withdrawn and protruded within limits owing to the muscles, which are connected with the posterior end. The retractor muscles (m. r.) attach to the head capsule on the inner side of the clypeus. The position of the invagination of the anterior arms of the tentorium, which are associated with the mandibles, enables one to homologise the mandibular setæ in the Jassoidea with the mandibles in the Cicadidæ and other Homoptera.

The identity of the mandibular plate or lora, has been well demonstrated by the work of Muir and Kershaw on the development of the Homopterous head, wherein it is shown that the mandibles become completely enclosed within the head-capsule. Although this question has been much discussed, from various points of view, it seems to the writer clear that the evidence favors the interpretation of the mandibular setæ as representing the entire mandible. The articulation of the mandibular setæ viz., between the clypeus and the maxilla is the normal position, and further the invagination of the anterior arms of the tentorium add additional weight to the interpretation.

The structure and morphology of the mandibular seta resembles very much that of the general Homopteron; the tips are barbed, with the barbs (b. a.) pointing backward. As stated before, their function is probably that of piercing the plant, to enable the maxillæ to perform the sucking function. Like the maxillary, the mandibular setæ are surrounded for their proximal half with a membranous sleeve.

Internal Anatomy. (Pl. XX, Figs. 2, 3, 4, 5, 8, 9, 10, 11; Pl. XXI, Fig. 22).

In the following discussion of the internal anatomy of the head, those structures previously mentioned will be omitted and only the parts which pertain directly to the internal structure will be considered.

Tentorium—(Figs. 4, 5). In the heads of all insects there is to be found a definite arrangement of supporting, chitinous structures, which owe their origin to three pairs of primary invaginations of the body wall. The structure itself consists of a system of rod or plate-like bodies, which constitute the tentorium or internal head skeleton. In the Jassid head this skeleton is present, but in some respects it has been modified. The three pairs of arms which compose the tentorium are known respectively as the anterior, dorsal and posterior arms. The anterior arms (i. a.) are invaginated on the cephalo-lateral edges of the clypeus; in the Jassid head this invagination is to be found at the upper corner of the so-called mandibular plate; it persists as an opening and can be distinctly seen in a specimen which has been boiled in KOH. In many insects the points of the invaginations do not persist in the adult. The anterior arms (i. a.) are always associated with the mandibles, and in the Jassid head they are to be found near the articulation of the mandibular setæ. The dorsal arms (d. a.) are invaginated beneath the antennæ and are easily seen in the head of Deltocephalus inimicus or any Jassoid. They are always associated with the antennæ, and in this case they occupy their normal position. While the invaginations themselves are not readily seen, the arms are quite prominent. The posterior arms (i. p.) are invaginated at the sides of the occipital foramen and are near the attachment of the maxilla. The upper ends of the posterior arms are connected by a chitinous bridge (the maxillary bridge of Muir and Kershaw), which is the body of the tentorium (t. b.). The latter divides the occipital foramen into two parts.

In the Jassoid head the parts of the tentorium have been modified to a certain extent, but nevertheless they can readily be homologised with the corresponding structures in the Cicada and other Homoptera. From the invagination of the anterior arms, on either side of the head, two small chitinous structures

run forward to the anterior edge of the clypeus; here they attach to the dorsal region of the clypeus, and at the same time are connected with one another by a narrow bridge, which is scarcely visible. From the anterior region of the pharynx two small tentorial structures attach to the anterior arms and form the chief means of support of the pharynx.

The posterior arms, the invaginations of which are connected by the body of the tentorium (t. b.), run forward along the ventral region of the head, as far as the salivary pumping apparatus (s. p.), where they attach on either side to the syringe. The body of the tentorium is very prominent and on either side it forms a means of support for the maxilla, to which it is attached. Its median portion supports various muscles, including those of the salivary pump and the labium. Passing up from the invagination, the posterior arms nearly surround the occipital foramen and join with the corresponding dorsal arms. The connection is not so very prominent, and in all the forms examined, the junction was confined to a mere tendon. The dorsal arms, which are to be found beneath the antennæ, are quite prominent in the dorsal region of the head. The size of the dorsal arms varies somewhat in different species; in Draculecephala mollipes they are short and branched, while in Deltocephalus inimicus and Agallia sanguinolenta they are much longer. Between the invaginations of the dorsal and anterior arms, small tendonous plates are to be seen.

In the Jassoid head, the correlation between the tentorial structures and the appendages of the head is to be found and forms the basis for their interpretation.

Epipharynx—(Pl. XX, Figs. 14, 1, 2, 3, 15). The anterior end of the dorsal plate of the pharynx is differentiated into the epipharynx (ep.), which is seen externally as the small peg covering the base of the labium. This structure is closely related to the labrum and in fact, the separation of the two is a difficult matter. The pharynx (ph.) continues along the under side of the labrum and passes out as the epipharynx. The epipharynx is fused with the anterior edge of the labrum, but a trace of the former condition can be seen.

Hypopharynx—(Pl. XX, Figs. 8, 15). The anterior end of the ventral plate of the pharynx is the hypopharynx (hyp.) and is a prominent structure in the mouth-cone of the Jassid.

It is broadly spoon-shaped, with the anterior end slightly pointed. Beneath it, the salivary pumping apparatus (s. p.) occurs and is in close relationship with its lower surface. The hypopharynx is heavily chitinized. The opening of the pharynx into the suction canal of the labium is surrounded by hypodermis, which encloses the setæ.

Pharynx—(Pl. XX, Fig. 5). The chitinous pharynx, as in all Hemiptera, constitutes a pumping apparatus, by means of which plant juices and other food are withdrawn into the digestive canal. The pharynx is a comparatively short, simple, chitinous tube, supported by strong muscles. The dorsal plate is somewhat elastic, and is capable of being withdrawn from the ventral plate by the pharyngeal muscles (ph. m.), which attach to the head-capsule along the inner surface of the clypeus. Apparently the pharynx is about the most powerful organ of the head, as the preponderance of pharyngeal muscles is obvious. The pharynx passes back over the body of the tentorium into the membranous esophagus.

The Salivary Pumping Apparatus—(Pl. XX, Figs. 8, 15). This characteristic Hemipterous structure is to be found beneath the base of the hypopharynx. It consists essentially of a broad spoon-shaped structure, into which fits the plunger (p.); the latter is slightly smaller than the spoon or barrel (b. a.) and functions as the driver of the apparatus. The plunger is developed backward into a thick rod (r.), to which attaches at its end the protractor muscles (p. p. s.). The united salivary ducts (s. d.) open into the base of the barrel, and by the forward motion of the plunger the saliva is forced forward through a small canal (s. d. h.), which leads to the anterior edge of the hypopharynx. At their entrance to the barrel the salivary ducts are chitinized. The protractor muscles (p. p. s.) of the plunger rod attach to the body of the tentorium, while the retractor muscles (p. r. s.) attach on the under side of the rod at one end and to the maxillary plates at the other. The plunger is thus capable of a forward and backward motion, by which means the saliva is pumped into the canal.

Salivary Glands—(Pl. XXI, Fig. 22). In the Jassoid head four separate salivary ducts are to be found; two pairs unite behind the salivary pump into one common duct, but farther back they separate into two pairs, which continue along the

floor of the mouth into the thorax. Both pairs of ducts end in glands, which are long structures, normally located in the abdomen. Each gland is whitish, and rather narrow. The salivary glands secrets the saliva which is carried forward into the pump and thence into the sucking tube.

THE THORAX.

The structure of the thorax was not studied in any degree of detail, and only reference to the more striking features will here be made. As in a generalised insect the thorax is composed of three segments, in order, the pro-, meso- and meta-thorax. The prothorax has undergone considerable modification and the traces of the sclerites seem to have been entirely lost. The dorsum or tergum is the large piece on the dorsal surface; it overlaps the mesonotum. Laterally the prothorax shows little differentiation into episternum and epimeron. The sternal region is reduced to a small piece, which bears the small chitinous apophyses. At the sides the first pair of legs are borne. The mesothorax is large and well developed, comprising a number of sclerites, which are separated with difficulty. Laterally it bears the tegmina and beneath the second pair of legs. The episternum and epimeron are easily recognised in this segment. A noticeable feature of the mesothorax is the great development of the musculature; the large wing muscles are very prominent. The apophyses are strongly developed. The metathorax is striking because of the great development in size of the hind coxæ; the latter are supported by very strong muscles. The sternal surface of the metathorax is almost completely overshadowed by the large coxæ.

THE ABDOMEN.

The Jassid abdomen is composed of at least eight segments, of which the first seven bear spiracles. Each abdominal segment is composed of a dorsal tergite and a ventral sternite, the two being connected by pleural membranes.

The modification of the posterior end of the abdomen for reproductive purposes has brought about a reduction in the number of apparent segments and many of these are recognised with difficulty. In the female the last abdominal segment is known as the pygofer (pyg.); through its dorsal region the anal

tube (an. t.) opens to the exterior. The ventral portion almost completely encloses the ovipositor (ovp.) which is generally a long, rather slender, heavily chitinized organ, hinged to the caudal end of the preceding segment. In its simplest form the ovipositor consists of two strong ventral valves (v. v.), which on being spread apart, expose the two inner valves (i. v.). The latter constitute the main part of the ovipositor and are small, sharp, slender pieces, which fit close together and so form a channel through which the ova may be extruded. The tip of the inner valves are barbed or sickle-shaped. The vagina opens into the anterior end of the channel. Beneath the inner valves are two large pieces which fit close together and compose the dorsal valves of the ovipositor. (d. v.).

The posterior region of the female abdomen as well as that of the male, shows a great deal of variation in the modification and advantage is taken of this for taxonomic purposes. The ventral abdominal segment just anterior to the ovipositor frequently shows a great deal of variation in shape. In the majority of the forms examined, however, the essential details of the female genital armature do not differ strikingly from the above.

In the male the last dorsal segment is known as the pygofer, and as in the female, the anal tube opens on it. Ventrally, the posterior of the abdomen is modified into a series of plates which afford protection for the penis. The uppermost of these plates is connected with the preceding abdominal segment and constitutes the valve (g. v.); it is generally triangular in shape, and extends about half way over the plates beneath. The latter are the genital plates (g. pl.) and are two long, somewhat rectangular pieces, which cover over the penis and penis guides. The genital plates vary considerably in size and shape, and advantage is taken of this character in the differentiation of species. In copulation the ventral valve bends down so as to allow the genital plates to spread apart, and the penis, with its accompanying guides is brought into action. The penis (pen.) is an elongate slender structure, which is strongly chitinized. It is hinged at the base of the pygofer, and is capable of considerable motion in a ventral direction.

Internal Anatomy.

The Digestive System. (Pl. XXI, Fig. 22; Pl. XXII, Fig. 34).

The chitinous pharynx passes back into the membranous esophagus (e. s.), which is a relatively short simple tube. In the metathorax, where the esophagus enters the midintestine, a constriction is noticed and a large food reservoir is developed. The latter structure is comparable to the food-reservoir of certain Fulgoridæ and Cercopidæ. The food-reservoir is a bilobed or double U-shaped structure, which opens into the intestinal coils; its function is probably that of a storage reservoir. From the reservoir the alimentary canal continues as a long, convoluted tube (m. i.) of small diameter; the length of midintestine is about two and a half times that of the body. It ends in the short rectum without differentiating into either colon or ileum. The rectum continues to the anus, which is located on the dorsal surface of the last abdominal segment.

Opening into the midintestine (m. i.) are the long Malpighian tubules (mp. t.); these are difficult to detect in the Jassid, but at length may be seen among the coils of the intestine. They are about the same length as the body and are of small diameter. There are only two pairs so far as was observed.

The food reservoir (f. res.), or crop, in Deltocephalus inimicus occurs entirely within the abdomen and does not enter the thorax. This seems to be the general condition, although in some forms it is to be found penetrating the thoracic region In some forms it occupies a great part of the anterior region of the abdominal cavity.

The digestive system may be readily dissected out of preserved specimens, although some little difficulty is experienced in keeping the coils of the intestine intact. It was noticed that in specimens which had been cleared in carbol-turpentine, there was a tendency on the part of the food reservoir to swell up and telescope through the dorsal wall of the abdomen.

The opening of the alimentary canal to the exterior, i. e., at the anus, is on the last abdominal segment and in the majority of individuals examined it was noticed that the anal orifice was beset with hairs and strong spines. The anal tube is a small structure, which is heavily chitinized. It conveys the feces to the exterior. In most individuals the anal tube is two-jointed, the basal joint being the longest.

Tracheal System. (Pl. XXII, Fig. 33).

The Tracheal System consists of the main trunk (m. t.) system connected with the spiracles (spi.). There are in most forms nine pairs of spiracles; two thoracic, and seven abdominal (I-VII), although in some species the abdominal number may be only six. The thoracic spiracles (t. spi.) are at first rather difficult to detect, but may be found below the wings on the episterna as two small, unprotected holes. On the abdomen the spiracles (ab. spi.) appear as small, elongate, narrow holes, located on the anterior halves of the segments, near the pleural membranes. Each spiracle connects with the main trunk system by a short tube.

The main trunk system (m. t.) comprises the two lateral tubes, which run down the sides of the body and anastomose. The two longitudinal trunks are connected by transverse trachea in the meso- and meta-thorax. The anastomosis in the thoracic trachea is best shown by reference to the Figure (Pl. XXII, Fig. 33). Two large transverse tubes connect the longitudinal trunks in the mesothorax, while in the metathorax the two transverse tubes do not open directly into the main trunks, but connect with the spiracle tube. A small tracheal tube runs between the two thoracic spiracles and gives off the branches which run to the wings. In the nymphs these tubes are very evident, although in the adult they are not so prominent. At the caudal end of the body the two trunks are in close relationship by means of their smaller branches, but no distinct tracheal connection is seen.

From the main longitudinal trunks arise the three systems of branches, the dorsal, visceral and ventral, which ramify through each segment, and portion of the body. Two strong branches are seen in the head, and supply the antennæ, mouthparts and the viscera of the head with trachea. Branches of the dorsal system can frequently be found in the dorsal muscles of the thorax, and in the peripheral region of the dorsum. The visceral system of branches supports the digestive apparatus and the reproductive organs, while the ventral system is closely connected with the nervous system and the ventral musculature.

Reproductive System. (Pl. XXII, Figs. 35, 36).

Female Organs—The paired ovaries (ov.), are normally located in the third segment of the abdomen, but frequently they occupy the greater portion of the abdominal cavity. Each ovary consists of six ovarian tubes (o. t.) or tubules, although this number is subject to some variation. Holmgren, who has studied the female organs in some detail gives the number of ovarian tubules in a Thamnotettix as twelve or two pairs of six each. Each ovarian tube (o. t.) is attached at a common point to the suspensor (sus), which in turn is supported by a tracheal branch in the dorsal region of the body. The length of the ovarian tubule varies greatly, but it frequently exceeds the abdomen; in many cases, as just before oviposition, the abdomen will be greatly distended by the numbers of eggs in the ovaries and on first examination it would seem that the whole abdominal cavity was filled with ova. In some cases the ovarian tubes may be pressed into the thoracic region, previous to oviposition. All the ovarian tubes unite caudally in a common oviduct (Ovd.) which is short and broad, although in some forms e. g. Cicadula, it may be long. The oviduct is frequently constricted before the opening of the receptaculum seminorum (rec. sem.) which is a semi-circular structure, lying to the side of the oviduct. The size of the receptaculum seminorum varies and may be large or small. Beyond the receptaculum seminorum the oviduct receives two pairs of accessory glands (ag^1, ag^2), which are very long and extend back into the abdomen. The vagina which is the terminal portion of the oviduct, opens into the ovipositor, through which the ova are extruded.

Male Organs—(Pl. XXII, Fig. 35). In the male each testis is composed of a varying number (usually six) follicles (f.). The testes which are located at the posterior end of the abdomen are yellowish in color, and are frequently enclosed in a whitish membrane. Each follicle is about three times as long as broad, and opens into the vas deferens (v. d.) by a separate duct. The vasa deferentia are about four times as long as broad and unite to form the ejaculatory duct (e. d.), which is merely a dilation before the penis or copulatory organ. Small accessory glands (a. g.) enter the vasa deferentia just before the ejaculatory duct.

Musculature System.

The most noteworthy features of the musculature system are the powerful muscles of the posterior region of the abdomen. The pygofer bears the muscles which support and work the strong ovipositor. The longitudinal muscles of the abdomen comprise the small ventral muscles of the body wall and the dorsal muscles. They are segmentally arranged. The lateral muscles of the abdomen are poorly developed and are confined to small strands which are situated along the sides of the body.

Nervous System.

The central nervous system (Pl. XXII, Fig. 32) consists of the brain (supraesophageal ganglion), the subesophageal ganglion, and the thoracic ganglion, with their attendant nerves and commissures.

The Brain (Br.) is relatively large and occupies the greater part of the dorsal region of the head. It emits two pairs of large nerves, which innervate the eyes (On.) and antennæ (An.) respectively. The brain is connected with the subesophageal ganglion by the circumesophageal commissures, which are rather small and not easily recognised. From the subesophageal ganglion small nerves pass to the maxillæ and labium.

The Thoracic Ganglia (T. G.) are fused into one large ganglion, located on the floor of the mesothorax. Small commissures connect the thoracic ganglion with the subesophageal, although the two appear to be continuous. Numerous nerves originate from the thoracic ganglion and pass to the legs, the dorsal muscles and the digestive apparatus.

There are no abdominal ganglia, but two strong nerves are seen passing back from the thoracic ganglion to the caudal end of the body. These two main abdominal nerves (Abd. N.) arise close to one another and are probably the result of the separation of the abdominal ganglia and commissures. They become widely separated as they pass down the body on either side of the median line. Each abdominal segment is supplied with nerves from these two main commissures and in addition the reproductive organs, the digestive apparatus and the excretory system are innervated.

While the Jassid nervous system does not differ very much from that of a generalized insect, it shows a specialization in the absence of the abdominal ganglia. However, this is not

an unusual state for the Homoptera, as Kershaw has shown that in the Fulgorid Pyrops candelaria, the structure and morphology of the nervous system is essentially the same. The abdominal ganglia have probably migrated forward and fused with the thoracic ganglia, leaving the abdominal commissures in their former position.

Circulatory System.

The Circulatory System so far as observed, consists of a long tube, or dorsal vessel, which runs the full length of the body, from the brain to the last abdominal segment. In general it is an undifferentiated tube, in which the blood circulates. The pulsation of the dorsal vessel may be observed by placing a living specimen under the binocular microscope, and watching the rhythmic movements of the abdomen. The vessel reaches the brain, which it supplies with blood and then apparently divides into two branches which pass into the body cavity.

Conclusions.

The studies enumerated above have led me to the conclusion that the Jassoidea can be homologised with the other Homopterous families. The head differs very little from the fundamental and generalised plan of the Cicada, and while the Jassid does not show the development of the prominent sulci, the structure of the mouthparts and head is very similar. The mandibular setæ represent the mandibles and the maxillary setæ, together with the maxillary plate constitute the maxillæ. While for systematic purposes we have been applying general terms to the regions of the head, it would seem impossible to change the nomenclature, so as to correspond with the morphological details. The labrum and clypeus are scarcely distinguishable from one another and the epipharynx is closely related to the labrum. The tentorium is present and the invaginations occur as in all insects. There is a well-developed salivary pumping apparatus. The epicranium is subject to some modification in size. There is a well developed nervous system, which is almost entirely cephalo-thoracic. The digestive system, in the development of a food-reservoir agrees with the other Auchenorrhynchous Homoptera. In general the plan and morphology of the internal organs follows that of a generalised Hemipteron, and the various modifications which occur in structure are just as likely to be specific as well as generic.

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ABBREVIATIONS.

A.—Antenna.
Ab. Spi.—Abdominal Spiracle.
Ag.—Accessory gland.
An.—Anus.
An. t.—Anal tube.
A. N.—Antennal Nerve.
a. m. s.—Articulation of the mandibular seta.
Abd. n.—Abdominal nerve.
Br.—Brain.
BA.—Barrel of salivary pump.
ba.—Barbs of mandibular seta.
C. C.—Circumesophageal commissure.
C.—Central muscles of labium.
c. m.—Circular muscles of labium.
Clyp.—Clypeus.
D. V.—Dorsal valve of ovipositor.
E.—Eye.
E. d.—Ejaculatory duct.
Es.—Esophagus.
E. p.—Entrance to penis.
ep.—Epipharnyx.
G. Pl.—Genital plate of male.
G. V.—Genital valve of male.
F.—Follicle.
Fr.—Front.
F. Res.—Food Reservoir.
Hyph.—Hypopharynx.
i. a.—Invagination of the anterior arms of tentorium.
i. d.—Invagination of dorsal arms of tentorium.
i. p.—Invagination of the posterior arms of the tentorium.
i. v.—Inner valve of ovipositor.
L.—Lateral muscles of labium.
lab.—Labium.
labr.—Labrum.
lab. ms.—Labial muscles.
m. a.—Attachment of mandibles to head-capsule.
mx. a.—Attachment of maxilla to head-capsule.
md.—Mandible.
mx.—Maxilla.
mi.—Midintestine.
m. p.—Protractor muscles of mandibular seta.
mx. p.—Protractor muscles of maxillary seta.
m. t.—Mandibular tendon.
mx. t.—Maxillary tendon.
Mx. pl.—Maxillary plate.
M. T.—Main Trunk of tracheal system.
Mp. T.—Malpighian Tubules.
m. r.—Retractor muscles of mandibular seta.
mx. r.—Retractor muscles of maxillary seta.
O.—Ocellus.
O. N.—Ocular nerve.
O. T.—Ovarian tubes.
Ov.—Ovary.
Ovd.—Oviduct.
Ovp.—Ovipositor.
O. F.—Occipital foramen.
Pen.—Penis.
P.—Plunger of salivary pump.
Ph.—Pharynx.
Ph. m.—Pharyngeal muscles.
Pl. c.—Plates of Clypeus.
Pyg.—Pygofer.
pps.—Protractor muscles of salivary pump.
prs.—Retractor muscles of salivary pump.
R.—Rod of plunger.
Rec Sem.—Receptaculum Seminorum.
Rec—Rectum.
S.—Seta.
sg.—Salivary gland.
sd.—Salivary duct.
Subg.—Subesophageal ganglion.
s. p.—Salivary pump.
sd. h.—Salivary duct to Hypopharynx.
Sus.—Suspensor.
T.—Tendon.
T. Spi.—Thoracic spiracle.
Tes.—Testis.
Tg.—Thoracic ganglion.
ta.—Arms of tentorium.
tb.—Body of tentorium.
ts.—Tentorial support.
tr.—Trachea.
V.—Vertex.
VV.—Ventral valve of ovipositor.
Vag.—Vagina.
V. D.—Vas Deferens.

EXPLANATION OF PLATES.

Plate XX.

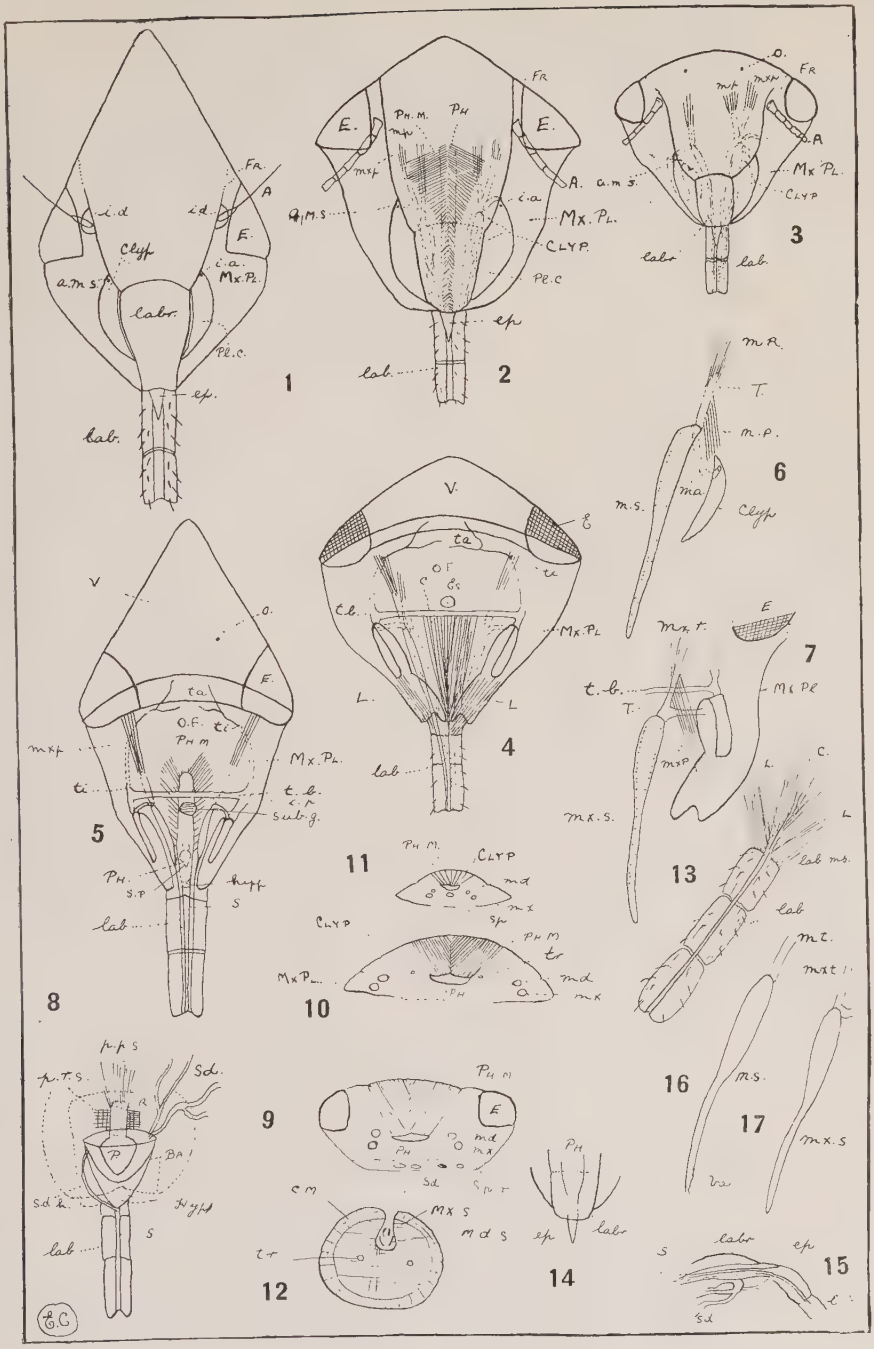
Fig. 1. Ventral view of head of Draeculacephala mollipes.
Fig. 2. Head of Deltocephalus inimicus. Ventral view.
Fig. 3. Head of Agallia sanguinolenta. Ventral view.
Fig. 4. Head of Deltocephalus inimicus. Caudal aspect.
Fig. 5. Head of Draeculacephala mollipes. Caudal aspect.
Fig. 6. Mandible of Deltocephalus inimicus.
Fig. 7. Maxilla of Deltocephalus inimicus.
Fig. 8. Salivary pumping apparatus of Deltocephalus inimicus.
Fig. 9. Cross section through head and eyes of Deltocephalus inimicus.
Fig. 10. Cross section through pharnyx of Deltocephalus inimicus.
Fig. 11. Cross section through anterior of clypeus of Deltocephalus inimicus.
Fig. 12. Cross section through labium of Draeculacephala mollipes.
Fig. 13. View of labium of Draeculacephala mollipes.
Fig. 14. Labrum and epipharynx of Draeculacephala mollipes.
Fig. 15. Side view of salivary pumping apparatus of Deltocephalus inimicus.
Fig. 16. Mandibular seta of Deltocephalus inimicus.
Fig. 17. Maxillary seta of Deltocephalus inimicus.

Plate XXI.

Fig. 18. Antenna of male Idiocerus.
Fig. 19. Antenna of Deltocephalus inimicus.
Fig. 20. Antenna of Cephalelus infumatus.
Fig. 21. Antenna of Gypona sp.
Fig. 22. Longitudinal median section through Draeculacephala mollipes (semi-diagrammatic).
Fig. 23. View of food reservoir.
Fig. 24. View of food reservoir.
Fig. 25. Ventral view of genitalia of Phlepsius irroratus. (male.)
Fig. 26. Side view of male genitalia of Phlepsius irroratus.
Fig. 27. Penis of Deltocephalus inimicus.
Fig. 28. Side view of inner valves of ovipositor of Deltocephalus inimicus.
Fig. 29. Ventral view of female genitalia of Draeculacephala mollipes. (Valves of ovipositor dissected free).
Fig. 30. Side view of ovipositor and female genitalia of Deltocephalus inimicus.
Fig. 31. Ventral view of female genitalia of Phlepsius irroratus.

Plate XXII.

Fig. 32. General dissection of Central Nervous System of Draeculacephala mollipes (semi-diagrammatic).
Fig. 33. General dissection of the tracheal system of Deltocephalus inimicus. (Semi-diagrammatic.)
Fig. 34. View of digestive system of Athysanus exitiosus.
Fig. 35. General dissection of the male reproductive organs.
Fig. 36. General dissection of the female reproductive organs.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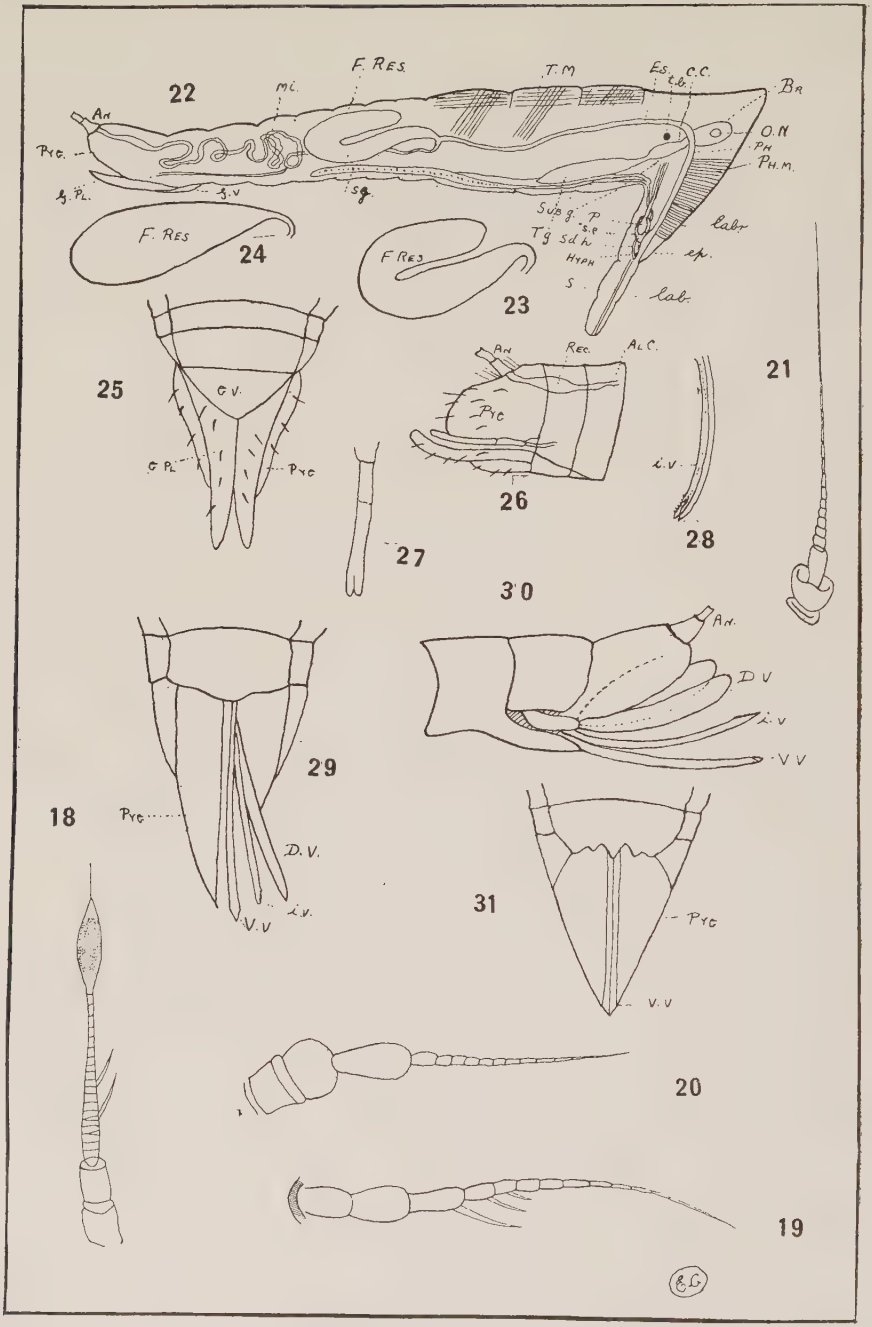
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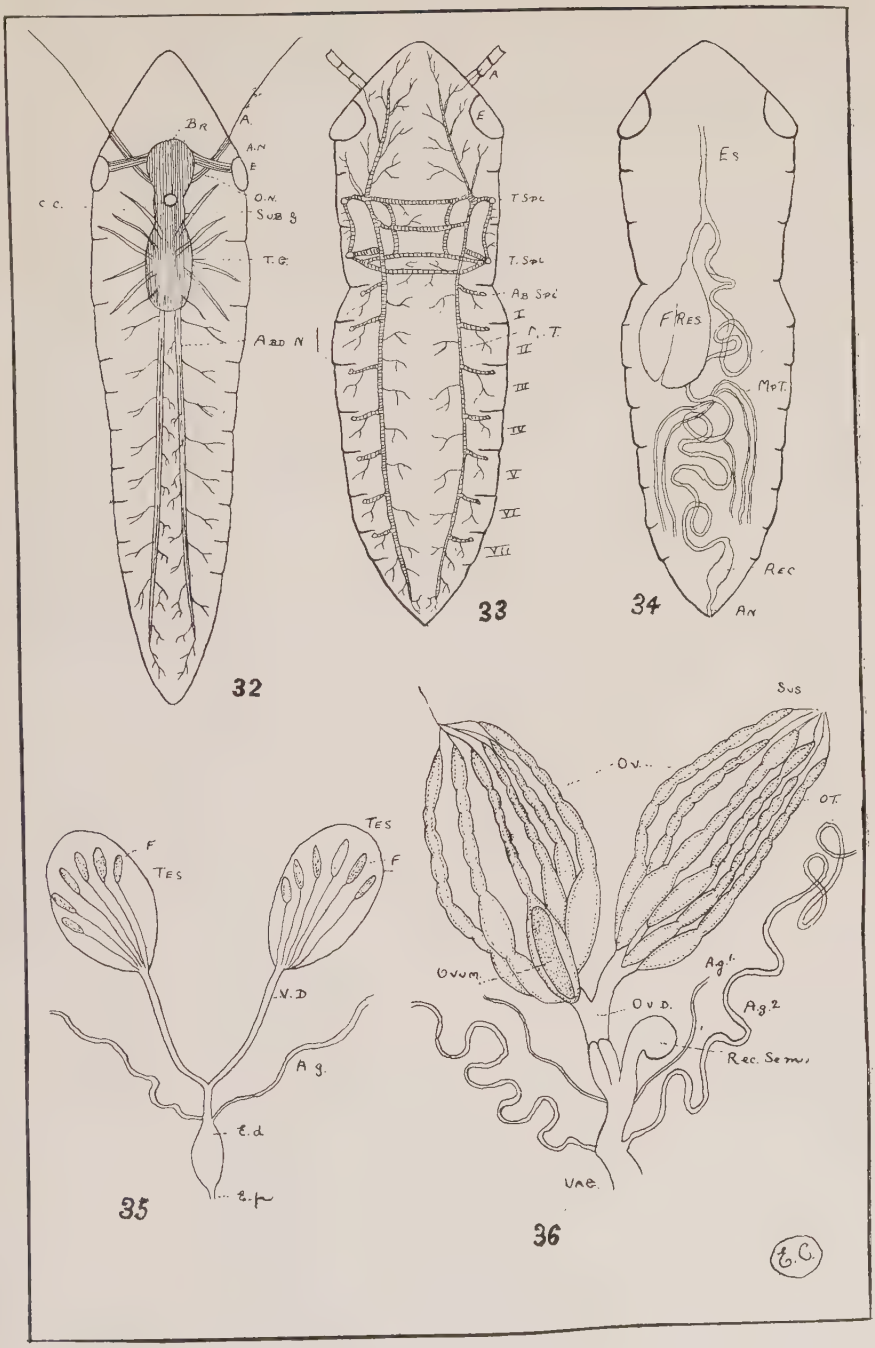
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VITA

Eric Sydney Earle Cogan was born at Grahamstown, Cape Province, Union of South Africa, on July 11, 1894. He received his early training at the Victoria High School, from which he matriculated in December, 1909. In February, 1910, he entered Rhodes University College at Grahamstown and in December, 1912, received the degree of Bachelor of Arts from the University of the Cape of Good Hope. In February, 1913, the Union Government of South Africa awarded him an Agricultural Scholarship for study abroad and he was advised to enter the Ohio State University with a view to taking special work in Entomology. The Summer of 1913 was spent at the Lake Laboratory, maintained by the Ohio State University under the direction of Professor Herbert Osborn. Since September, 1913, he has been enrolled as a graduate student in the Ohio State University, receiving the degree of Master of Arts from that institution in June, 1914. The Summer of 1915 was spent with the U. S. Bureau of Entomology, in the Division of Cereal and Forage Crop Investigations.